

4. Information collected is used by VA to determine whether the veteran qualifies as a prospective mortgagor for mortgage insurance or guaranty or

as a borrower for a rehabilitation loan under the VA program

5. On occasion

6. Business or other for-profit

7. 250,000 responses

8. 1/12 hour

9. Not applicable.

[FR Doc. 89-12146 Filed 5-19-89; 8:45 am]

BILLING CODE 8320-01-M

# Sunshine Act Meetings

Federal Register

Vol. 54, No. 97

Monday, May 22, 1989

This section of the FEDERAL REGISTER contains notices of meetings published under the "Government in the Sunshine Act" (Pub. L. 94-409) 5 U.S.C. 552b(e)(3).

## FEDERAL MINE SAFETY AND HEALTH REVIEW COMMISSION

May 17, 1989.

**TIME AND DATE:** 2:00 p.m., Wednesday, May 24, 1989.

**PLACE:** Room 600, 1730 K Street, N.W., Washington, D.C.

**STATUS:** Open.

**MATTERS TO BE CONSIDERED:** The Commission will consider and act upon the following:

1. *Tracey and Partners, et al. v. Secretary of Labor*, Docket Nos. PENN 87-121-R, etc. (Issues include whether the judge erred in concluding that the operator did not violate Section 103(a) of the Mine Act. 30 U.S.C. 813(a).)

Any person intending to attend this meeting who requires special

accessibility features and/or auxiliary aids, such as sign language interpreters, must inform the Commission in advance of those needs. Subject to 29 CFR § 2706.150(a)(3) and § 2706.160(d).

**CONTACT PERSON FOR MORE INFO:** Jean Ellen (202) 653-5629/(202) 566-2673 for TDD Relay.

Jean H. Ellen,  
Agenda Clerk.

[FR Doc. 89-12354 Filed 5-18-89; 3:33 pm]

BILLING CODE 6735-01-M



# Corrections

Federal Register

Vol. 54, No. 97

Monday, May 22, 1989

This section of the FEDERAL REGISTER contains editorial corrections of previously published Presidential, Rule, Proposed Rule, and Notice documents. These corrections are prepared by the Office of the Federal Register. Agency prepared corrections are issued as signed documents and appear in the appropriate document categories elsewhere in the issue.

## THE PRESIDENT

### 3 CFR

#### Proclamation 5963 of April 28, 1989

#### Bicentennial Celebration of the Inauguration of George Washington

##### Correction

In Presidential Proclamation 5963 beginning on page 18863 in the issue of Tuesday, May 2, 1989, make the following correction:

The first sentence of the third paragraph should read, "Revered for his leadership during the Revolutionary War, Washington was elected to office by a unanimous vote in 1789."

The correction was requested by Ronald Geisler, Executive Clerk of the White House, in a memorandum to the

Director of the Federal Register, dated May 17, 1989.

BILLING CODE 1505-01-D

## ENVIRONMENTAL PROTECTION AGENCY

### 40 CFR Part 81

[FRL-3527-7; KY-050]

#### Designation of Areas for Air Quality Planning Purposes; Kentucky: Redefinition of Attainment Area From Rest of State to County-by-County

##### Correction

In rule document 89-4297 beginning on page 8322 in the issue of Tuesday, February 28, 1989, make the following corrections:

##### § 81.318 [Corrected]

1. On page 8324, in the table, in the first column, in the first entry, "Bolye" should read "Boyle".
2. On the same page, in the table, in the same column, in the 43rd entry, remove the "D" after "County".
3. On the same page, in the table, in the second column, in place of the 10th broken line from the bottom, (corresponding with McCracken County), insert an "X".

4. On the same page, in the table, in the same column, remove the "X" that appears above the eighth broken line from the bottom (corresponding with "That portion of Madison County in Richmond").

BILLING CODE 1505-01-D

## ENVIRONMENTAL PROTECTION AGENCY

### 40 CFR Part 160

[OPP-250081; FRL-3565-1]

#### Notification to Secretary of Agriculture of the Final Revision to the Federal Insecticide, Fungicide, and Rodenticide Act; Good Laboratory Practice Standards

##### Correction

In proposed rule document 89-10404 appearing on page 18912 in the issue of Wednesday, May 3, 1989, make the following correction:

In the first column, under **SUPPLEMENTARY INFORMATION**, in the 13th line, before "Secretary's" insert "Secretary, and the response of the Administrator concerning the".

BILLING CODE 1505-01-D



# Federal Register

Monday  
May 22, 1989

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## Part II

### Environmental Protection Agency

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40 CFR Parts 141, 142 and 143  
National Primary and Secondary  
Drinking Water Regulations; Proposed  
Rule



# ENVIRONMENTAL PROTECTION AGENCY

## 40 CFR Parts 141, 142, and 143

[WH-FRL-3380-1]

## National Primary and Secondary Drinking Water Regulations

**AGENCY:** Environmental Protection Agency (EPA).

**ACTION:** Proposed rule.

**SUMMARY:** In this notice, EPA is repropose maximum contaminant level goals (MCLGs) and proposing National Primary Drinking Water Regulations (NPDWRs) for 30 synthetic organic chemicals (SOCs) and 8 inorganic chemicals (IOCs). The NPDWRs consist of maximum contaminant levels (MCLs) or treatment techniques for the SOCs and IOCs. The NPDWRs also include proposed monitoring, reporting, and public notification requirements for these compounds. This notice proposes the best available technology (BAT) upon which the MCLs are based and the BAT for the purpose of issuing variances. In addition to the NPDWRs for the SOCs and IOCs, the Agency is also proposing secondary MCLs (SMCLs) for nine contaminants. Monitoring requirements for approximately 100 synthetic organic chemicals and inorganic chemicals which are not regulated by NPDWRs are also proposed in this notice.

**DATES:** Written comments must be submitted by August 21, 1989. A public hearing will be held at EPA's Education Center auditorium, 401 M Street SW., Washington, DC 20460, on July 12, 1989 and, if needed, on July 13, 1989, beginning at 9:00 a.m. If additional time is needed to accommodate statements at the hearing, the hearing will be extended to July 13.

**ADDRESSES:** Send written comments on the proposed rule to SOCs/IOCs Comment Clerk, Criteria and Standards Division, Office of Drinking Water (WH-550D), Environmental Protection Agency, 401 M Street SW., Washington, DC 20460. Commenters are requested to submit any references cited in their written or oral comments. A copy of the comments and supporting documents are available for review at the EPA, Drinking Water Docket, 401 M Street SW., Washington, DC 20460. For access to the docket materials, call 202-382-3027 between 9:00 a.m. and 3:30 p.m. Anyone planning to attend the public hearing (especially those who plan to make statements) may register in advance by calling or writing the Office of Drinking Water at 202-382-7584, EPA.

WH-550-D, 401 M Street SW., Washington, DC 20460. Persons planning to make statements at the hearing should submit written copies of their remarks at the time of the hearing.

Copies of draft health criteria, analytical methods, and regulatory impact analysis documents are available at some Regional Offices listed below and for a fee from the National Technical Information Service (NTIS), U.S. Department of Commerce, 5285 Port Royal Road, Springfield, Virginia 22161. The toll-free number is 800/336-4700, local: 703/487-4650.

**FOR FURTHER INFORMATION CONTACT:** Al Havinga, Criteria and Standards Division, Office of Drinking Water (WH-550), U.S. Environmental Protection Agency, 401 M Street SW., Washington, DC 20460, 202/382-5555, or one of the EPA Regional Office contacts listed below. General information may also be obtained from the EPA Drinking Water Hotline. The toll-free number is 800/426-4791, local: 202/382-5533.

### EPA Regional Offices

- I. JFK Federal Bldg., Room 2203, Boston, MA 02203, Phone: (617) 565-3602, Jerry Healey
- II. 26 Federal Plaza, Room 824, New York, NY 10278, Phone: (212) 264-1800, Walter Andrews
- III. 841 Chestnut Street, Philadelphia, PA 19107, Phone: (215) 597-8227, Jon Capacasa
- IV. 345 Courtland Street, Atlanta, GA 30365, Phone: (404) 347-2913, Wesley Crum
- V. 230 S. Dearborn Street, Chicago, IL 60604, Phone: (312) 353-2152, Joseph Harrison
- VI. 1445 Ross Avenue, Dallas, TX 75202, Phone: (214) 255-7155, Oscar Cabra
- VII. 726 Minnesota Ave., Kansas City, KS 66101, Phone: (913) 234-2815, Ralph Langemeier
- VIII. One Denver Place, 999 18th Street, Suite 300, Denver, CO 80202-2413, Phone: (303) 293-1408, Patrick Crotty
- IX. 215 Fremont Street, San Francisco, CA 94105, Phone: (415) 974-0912, Steve Pardieck
- X. 1200 Sixth Avenue, Seattle, WA 98101, Phone: (206) 442-4092, Richard Thiel

### SUPPLEMENTARY INFORMATION:

Abbreviations used in this notice.

BAT: Best Available Technology  
BTGA: Best Technology Generally Available  
CWS: Community Water System  
DWEL: Drinking Water Equivalent Level  
EMSL: EPA Environmental Monitoring and Support Laboratory (Cincinnati)  
GAC: Granular Activated Carbon  
IOC: Inorganic Chemical  
LOQ: Limit of Quantitation  
MCL: Maximum Contaminant Level (expressed as mg/l)<sup>1</sup>

<sup>1</sup> 1,000 micrograms (ug) = 1 milligram (mg)

MCLG: Maximum Contaminant Level Goal  
MDL: Method Detection Limit  
MGD: Million Gallons per Day  
NIPDWR: National Interim Primary Drinking Water Regulation  
NPDWR: National Primary Drinking Water Regulation  
NTNCWS: Non-transient Non-community Water System  
POE: Point-of-Entry Technologies  
POU: Point-of-Use Technologies  
PQL: Practical Quantitation Level  
PTA: Packed Tower Aeration  
PWS: Public Water System  
RIA: Regulatory Impact Analysis  
RMCL: Recommended Maximum Contaminant Level  
RSC: Relative Source Contribution  
SDWA: Safe Drinking Water Act, or the "Act," as amended in 1986  
SMCL: Secondary Maximum Contaminant Level  
SOC: Synthetic Organic Chemical  
VOC: Volatile Synthetic Organic Chemical

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## I. Summary of Today's Action

## Proposed MCLGs for inorganic chemicals:

- (1) Asbestos..... 7 million fibers/  
liter (longer than  
10  $\mu$ )
- (2) Barium ..... 5 mg/1
- (3) Cadmium ..... 0.005 mg/1
- (4) Chromium ..... 0.1 mg/1
- (5) Mercury ..... 0.002 mg/1
- (6) Nitrate<sup>1</sup> ..... 10 mg/1 (as N)
- (7) Nitrite<sup>1</sup> ..... 1 mg/1 (as N)
- (8) Selenium ..... 0.05 mg/1

## Proposed MCLGs for synthetic organic chemicals:

- (1) Acrylamide ..... Zero
- (2) Alachlor ..... Zero
- (3) Aldicarb ..... 0.01 mg/1
- (4) Aldicarb sulfonide ..... 0.01 mg/1
- (5) Aldicarb sulfone ..... 0.04 mg/1
- (6) Atrazine ..... 0.003 mg/1
- (7) Carbofuran ..... 0.04 mg/1
- (8) Chlordane ..... Zero
- (9) o-Dibromochloropropane (DBCP) ..... Zero
- (10) o-Dichlorobenzene ..... 0.6 mg/1
- (11) cis-1,2-Dichloroethylene ..... 0.07 mg/1
- (12) trans-1,2-Dichloroethylene ..... 0.1 mg/1
- (13) 1,2-Dichloropropane ..... Zero
- (14) 2,4-D ..... 0.07 mg/1
- (15) Epichlorohydrin ..... Zero
- (16) Ethylbenzene ..... 0.7 mg/1
- (17) Ethylene dibromide (EDB) ..... Zero
- (18) Heptachlor ..... Zero
- (19) Heptachlor epoxide ..... Zero
- (20) Lindane ..... 0.0002 mg/1
- (21) Methoxychlor ..... 0.4 mg/1
- (22) Monochlorobenzene ..... 0.1 mg/1
- (23) Polychlorinated biphenyls (PCBs) (as decachlorobiphenyl) ..... Zero
- (24) Pentachlorophenol ..... 0.2 mg/1
- (25) Styrene ..... Zero/0.1 mg/1<sup>2</sup>
- (26) Tetrachloroethylene ..... Zero
- (27) Toluene ..... 2 mg/1
- (28) Toxaphene ..... Zero
- (29) 2,4,5-TP (Silvex) ..... 0.05 mg/1
- (30) Xylenes (total) .. 10 mg/1

## Proposed MCLs for inorganic chemicals:

- (1) Asbestos..... 7 million fibers/  
liter (longer than  
10  $\mu$ )
- (2) Barium ..... 5 mg/1
- (3) Cadmium ..... 0.005 mg/1
- (4) Chromium ..... 0.1 mg/1
- (5) Mercury ..... 0.002 mg/1
- (6) Nitrate<sup>1</sup> ..... 10 mg/1 (as N)
- (7) Nitrite<sup>1</sup> ..... 1 mg/1 (as N)
- (8) Selenium ..... 0.05 mg/1

## Proposed MCLs for synthetic organic chemicals:

- (1) Acrylamide ..... Treatment technique
- (2) Alachlor ..... 0.002 mg/1
- (3) Aldicarb ..... 0.01 mg/1
- (4) Aldicarb sulfonide ..... 0.01 mg/1
- (5) Aldicarb sulfone ..... 0.04 mg/1
- (6) Atrazine ..... 0.003 mg/1
- (7) Carbofuran ..... 0.04 mg/1
- (8) Chlordane ..... 0.002 mg/1
- (9) Dibromochloropropane (DBCP) ..... 0.0002 mg/1
- (10) o-Dichlorobenzene ..... 0.6 mg/1
- (11) cis-1,2-Dichloroethylene ..... 0.07 mg/1
- (12) trans-1,2-Dichloroethylene ..... 0.1 mg/1
- (13) 1,2-Dichloropropane ..... 0.005 mg/1
- (14) 2,4-D ..... 0.07 mg/1
- (15) Epichlorohydrin ..... Treatment technique
- (16) Ethylbenzene ..... 0.7 mg/1
- (17) Ethylene dibromide (EDB) ..... 0.00005 mg/1
- (18) Heptachlor ..... 0.0004 mg/1
- (19) Heptachlor epoxide ..... 0.0002 mg/1
- (20) Lindane ..... 0.0002 mg/1
- (21) Methoxychlor ..... 0.4 mg/1
- (22) Monochlorobenzene ..... 0.1 mg/1
- (23) Polychlorinated biphenyls (PCBs) (as decachlorobiphenyl) ..... 0.0005 mg/1
- (24) Pentachlorophenol ..... 0.2 mg/1
- (25) Styrene ..... 0.005 mg/1/0.1 mg/1<sup>2</sup>
- (26) Tetrachloroethylene ..... 0.005 mg/1
- (27) Toluene ..... 2 mg/1
- (28) Toxaphene ..... 0.005 mg/1
- (29) 2,4,5-TP (Silvex) ..... 0.05 mg/1
- (30) Xylenes (total) .. 10 mg/1

<sup>1</sup> In addition, MCLG for total nitrate and nitrite = 10 mg/1 (as N).<sup>2</sup> EPA proposes MCLGs of 0.1 mg/1 based on a Group C carcinogen classification and zero based on a B<sub>2</sub> classification.<sup>1</sup> In addition, MCL for total nitrate and nitrite = 10.0 mg/1 (as N).<sup>2</sup> EPA proposes MCLs of 0.1 mg/1 based on a Group C carcinogen classification and .005 mg/1 based on a B<sub>2</sub> classification.

## Proposed SMCLs:

- (1) Aluminum ..... 0.05 mg/1
- (2) o-Dichlorobenzene ..... 0.01 mg/1
- (3) p-Dichlorobenzene ..... 0.005 mg/1
- (4) Ethylbenzene ..... 0.03 mg/1
- (5) Pentachlorophenol ..... 0.03 mg/1
- (6) Silver ..... 0.09 mg/1
- (7) Styrene ..... 0.01 mg/1
- (8) Toluene ..... 0.04 mg/1
- (9) Xylene ..... 0.02 mg/1

## Proposed BAT for IOCs:

- Asbestos..... Coagulation/Filtration; Direct & Diatomite Filtration; Corrosion Control.
- Barium ..... Ion Exchange; Lime Softening; Reverse Osmosis.
- Cadmium ..... Ion Exchange; Reverse Osmosis; Coagulation/Filtration; Lime Softening.
- Chromium .... Coagulation/Filtration; Ion Exchange; Lime Softening (Chromium III only); Reverse Osmosis.
- Mercury ..... Granular Activated Carbon; Coagulation/Filtration<sup>1</sup>; Powdered Activated Carbon<sup>1</sup>; Lime Softening<sup>1</sup>; Reverse Osmosis<sup>1</sup>.
- Nitrate/Nitrite. Ion Exchange; Reverse Osmosis.
- Selenium ..... Activated Alumina; Lime Softening; Coagulation/Filtration (Selenium IV only); Reverse Osmosis.

<sup>1</sup> Mercury influent concentrations <10 ug/1.

## Proposed BAT for SOC:

Chemical	GAC <sup>1</sup>	PTA <sup>2</sup>	PAP <sup>3</sup>
Acrylamide.....			X
Alachlor .....	X		
Aldicarb.....	X		
Aldicarb sulfone.....	X		
Aldicarb sulfoxide.....	X		
Atrazine .....	X		
Carbofuran.....	X		
Chlordane.....	X		
2,4-D.....	X		
Dibromochloropropane (DBCP).....	X	X	
o-Dichlorobenzene.....	X	X	
cis-1,2-Dichloroethylene.....	X	X	
trans-1,2-Dichloroethylene.....	X	X	
1,2-Dichloropropane.....	X	X	
Epichlorohydrin.....			X
Ethylene Dibromide (EDB).....	X	X	
Ethylbenzene.....	X	X	
Heptachlor.....	X		
Heptachlor epoxide.....	X		
Lindane.....	X		
Methoxychlor.....	X		
Monochlorobenzene.....	X	X	
PCBs.....	X		
Pentachlorophenol.....	X		
Styrene.....	X	X	
2,4,5-TP (Silvex).....	X		
Tetrachloroethylene.....	X	X	
Toluene.....	X	X	
Toxaphene.....	X		
Xylene (Total).....	X	X	



<sup>1</sup> GAC=Granular Activated Carbon.<sup>2</sup> PTA=Packed Tower Aeration.<sup>3</sup> PAP=Polymer Addition Practices.

## PROPOSED COMPLIANCE MONITORING REQUIREMENTS

[Community and Non-Transient Systems]

Contaminant	Vulnerability assessment required	Non-vulnerable		Vulnerable <sup>1</sup>	
		Surface	Ground	Surface	Ground
I. Regulated contaminants:					
Inorganics .....					
Barium .....	Yes .....	Initial: Annually .....	Initial: Every 3 years .....	Not applicable .....	Not applicable .....
Cadmium .....	No .....	Repeat: Minimum of every 10 years after 3 rounds completed.	Repeat: Minimum of every 10 years after 3 rounds completed.		
Chromium .....	No .....				
Mercury .....	No .....				
Selenium .....	No .....				
Asbestos .....	Yes, to determine repeat monitoring.	No monitoring required.	No monitoring required.	Initial: 1 time .....	Initial: 1 time .....
Nitrate/Nitrite <sup>2</sup> .....	No .....	Quarterly (Reduced to annually if concentration is <50% of MCL).	Annually (Quarterly if concentration >50% of MCL).	Repeat: Every 3 years if initial result is >50% of MCL.	Repeat: Annually if initial result is >50% of MCL.
Synthetic Organics:					
(a) VOCs					
cis-1,2-Dichloro-ethylene	Yes, for repeat frequency.	Initial: Quarterly for 1 year. Repeat: State discretion.	Initial: Quarterly for 1 year. Repeat: 5 years .....	Initial: Quarterly for 1 year.	Initial: Quarterly for 1 year.
trans-1,2-Dichloro-ethylene				Repeat: VOCs detected—Quarterly.	Repeat: VOCs detected—Quarterly.
1,2-Dichloropropane				VOCs not detected—	VOCs not detected—
o-Dichlorobenzene				>500 connections—	>500 connections—
Ethylbenzene				every 3 years.	every 3 years.
Monochlorobenzene				<500 connections—	<500 connections—
Styrene				every 5 years.	every 5 years.
Tetrachloroethylene					
Toluene					
Xylene					
(b) Pesticides and PCBs					
Alachlor	Yes, for initial sampling.	No monitoring required.	No monitoring required.	Initial: Quarterly for 1 year.	Initial: Quarterly for 1 year.
Aldicarb				Repeat: Detected—	Repeat: Detected—
Aldicarb sulfone				>500 connections—	>500 connections—
Aldicarb sulfoxide				quarterly.	quarterly.
Atrazine				<500 connections—	<500 connections—
Carbofuran				Annually.	Annually.
Chlordane				Not detected—	Not detected—
Dibromochloropropane 2,4-D				>500 connections—4	>500 connections—4
Ethylene dibromide				quarterly samples	quarterly samples
Heptachlor				every 3 years.	every 3 years.
Heptachlor epoxide				<500 connections—4	<500 connections—4
Lindane				quarterly samples	quarterly samples
Methoxychlor				every 5 years.	every 5 years.
Pentachlorophenol					
Toxaphene 2,4,5-TP					
PCBs					
II. Unregulated contaminants:					
6 IOCs .....	Yes .....	No requirement .....	No requirement .....	1 time only .....	1 time only .....
23 SOCs .....	Yes .....	No requirement .....	No requirement .....	4 quarterly samples for 1 year.	4 quarterly samples for 1 year.
82 SOCs .....	No .....	No requirement .....	No requirement .....	State discretion .....	State discretion .....

Note: This chart is a summary of the proposed monitoring requirements. The reader should consult the proposed rule for a full description of those requirements.

<sup>1</sup> Based upon assessment.<sup>2</sup> Non-community groundwater systems are required to monitor every three years; non-community surface water systems are required to monitor annually.

Analytical methods for inorganic chemicals:

Contaminant and methodology:

Asbestos: Transmission electron microscopy

Barium:

Atomic absorption; furnace technique <sup>1</sup>



Atomic absorption; direct aspiration<sup>2</sup>  
Inductively-coupled plasma<sup>3</sup>  
Cadmium:  
Atomic absorption; furnace technique<sup>1</sup>  
Inductively-coupled plasma<sup>3</sup>  
Chromium:  
Atomic absorption; furnace technique<sup>1</sup>  
Atomic absorption; direct aspiration<sup>2</sup>  
Inductively-coupled plasma<sup>3</sup>  
Mercury:  
Manual cold vapor technique  
Automated cold vapor technique  
Nitrate:  
Manual cadmium reduction  
Automated hydrazine reduction  
Automated cadmium reduction  
Ion selective electrode  
Ion chromatography  
Nitrite:  
Spectrophotometric  
Automated cadmium reduction  
Manual cadmium reduction  
Ion chromatography  
Selenium:  
Atomic absorption; gaseous hydride  
Atomic absorption; furnace<sup>1</sup>

<sup>1</sup> Graphite Furnace Atomic Absorption Spectroscopy (GFAA).

<sup>2</sup> Direct Aspiration Atomic Absorption Spectroscopy (AA).

<sup>3</sup> Inductively Coupled Plasma—Atomic Emission Spectroscopy (ICP—AES).

#### *Analytical Methods for Volatile Organic Chemicals*

1. EPA Methods 502.1; 502.2; 503.1; 524.1, and 524.2 are currently used to analyze the 8 VOCs promulgated on July 8, 1987.

#### *Analytical Methods for Pesticides and PCBs*

1. EPA Method 504: Dibromochloropropane; Ethylene Dibromide.
2. EPA Method 505: Alachlor, Atrazine, Chlordane, Heptachlor, Heptachlor Epoxide, Lindane, Methoxychlor, Toxaphene, and PCBs (as Aroclors). Method 505 can be used to screen for PCBs.
3. EPA Method 507: Alachlor, Atrazine.
4. EPA Method 508: Chlordane, Heptachlor, Heptachlor Epoxide; Lindane; Methoxychlor. Method 508 can be used to screen for PCBs.
5. EPA Method 508A: PCBs (as decachlorobiphenyl).
6. EPA Method 515.1: 2,4-D; 2,4,5-TP (Silvex); Pentachlorophenol.
7. EPA Method 531.1: Aldicarb; Aldicarb sulfone; Aldicarb sulfoxide; Carbofuran.

#### *Laboratory Certification Criteria*

- IOCs

Asbestos..... 2 standard deviations based on study statistics  
Barium .....  $\pm 15\%$  at  $\geq 0.15$  mg/L  
Cadmium .....  $\pm 20\%$  at  $\geq 0.002$  mg/L  
Chromium .....  $\pm 15\%$  at  $\geq 0.01$  mg/L  
Fluoride .....  $\pm 10\%$  at 1 to 10 mg/L  
Mercury .....  $\pm 30\%$  at  $\geq 0.0005$  mg/L  
Nitrate .....  $\pm 10\%$  at  $\geq 0.4$  mg/L  
Nitrite .....  $\pm 10\%$  at  $\geq 0.4$  mg/L  
Selenium .....  $\pm 20\%$  at  $\geq 0.01$  mg/L

#### • VOCs

$\pm 20$  percent  $\geq 0.010$  mg/l  
 $\pm 40$  percent  $\geq 0.010$  mg/l

#### • Pesticides and PCBs:

Two standard deviations based on study statistics.

#### *Variances and Exemptions*

Under section 1415, EPA or a State which has primary enforcement responsibility may issue a variance if it determines that a system cannot comply with an MCL despite application of BAT. The proposed section 1415 BAT for IOCs are the same technologies as those listed above for section 1412 BAT, except coagulation/filtration and lime softening are not proposed for small systems. Proposed BAT for the SOC's are the same technologies as the BAT listed above.

EPA or a State may not issue a variance or exemption if an unreasonable risk to health exists. Before granting a variance or exemption, EPA or the State must require public water systems to provide point-of-use (POU) devices, bottled water or other means to reduce exposure below unreasonable risk to health values.

#### *State Primacy, Recordkeeping, Reporting Requirements*

- State Primacy Requirements
  - State procedures for conducting vulnerability assessments
  - State procedures for determining whether a system may reduce monitoring frequencies
- State Recordkeeping Requirements
  - System vulnerability assessment determinations
  - Determinations that a system may reduce monitoring frequency
  - Determinations relating to repeat monitoring for asbestos
  - Records of decisions that systems must monitor for the unregulated contaminants
  - Letters from systems with less than 150 service connections stating their availability for monitoring for unregulated contaminants
  - Annual system certifications for epichlorohydrin and acrylamide
- State Reporting Requirements

- A list of systems for which the State conducted a vulnerability assessment
- A list of systems for which the State reduced monitoring frequencies
- Analytical results of unregulated contaminant monitoring
- A list of systems with less than 150 service connections which sent letters to the State stating their availability for monitoring for unregulated contaminants
- A list of systems which certified compliance with the treatment technique requirement for epichlorohydrin and acrylamide

#### II. Statutory Authority

Section 1412 of the Safe Drinking Water Act, as amended in 1986 ("SDWA" or "the Act"), requires EPA to publish Maximum Contaminant Level Goals (MCLGs) and promulgate National Primary Drinking Water Regulations (NPDWRs) for contaminants in drinking water which may cause any adverse effect on the health of persons and which are known or anticipated to occur in public water systems. Under section 1401, the NPDWRs are to include Maximum Contaminant Levels (MCLs) and "criteria and procedures to assure a supply of drinking water which dependably complies" with such MCLs. Under section 1412(b)(7)(A), if it is not economically or technically feasible to ascertain the level of a contaminant in drinking water, EPA may require the use of a treatment technique instead of an MCL.

Under section 1412(b), EPA is to establish MCLGs and promulgate national primary drinking water regulations for 83 contaminants by June 19, 1989 (see Appendix A for a list of the 83 contaminants). Regulations were to be promulgated by June 19, 1987 for 9 contaminants, by June 19, 1988 for 40 additional contaminants and by June 19, 1989 for the remaining 34 contaminants. An additional 25 contaminants are to be regulated every 3 years.

#### *A. MCLGs, MCLs and BAT*

EPA is to establish MCLGs at the level at which no known or anticipated adverse effects on the health of persons occur and which allow an adequate margin of safety. MCLGs are nonenforceable health goals. MCLs are enforceable standards which the Act directs EPA to set as close to the MCLGs as feasible. "Feasible" means feasible with the use of the best technology, treatment techniques, and other means which the Administrator finds available (taking cost into consideration) after examination for



efficacy under field conditions and not solely under laboratory conditions. Also, the SDWA requires the Agency to identify the best available technology (BAT) which is feasible for meeting the MCL for each contaminant.

#### B. Variances and Exemptions

Section 1415 authorizes the State (the term "State" is used in this preamble to mean the State agency with primary enforcement responsibility for the public water supply system program or EPA if the State does not have primacy) to issue variances from NPDWRs. The State may issue a variance if it determines that a system cannot comply with an MCL despite application of the best available technology (BAT). Under section 1415, EPA must propose and promulgate its finding of the best available technology, treatment techniques, or other means available for each contaminant, for purposes of section 1415 variances, at the same time that it proposes and promulgates a maximum contaminant level for such contaminant. EPA's finding of BAT, treatment techniques, or other means for purposes of issuing variances may vary among systems, depending upon the number of persons served by the system or for other physical conditions related to engineering feasibility and costs of complying with MCLs, as considered appropriate by EPA. The State may not issue a variance where an unreasonable risk to health exists. When a State grants a variance, it must at the same time prescribe a schedule for compliance with the NPDWR and implementation of any additional control measures.

Under section 1416(a), the State may exempt a public water system from any MCL or treatment technique requirement if it finds that: (1) Due to compelling factors (which may include economic factors), the system is unable to comply, (2) the system was in operation on the effective date of the MCL or treatment technique, or, for a newer system, that no reasonable alternative source of drinking water is available to that system, and (3) the exemption will not result in an unreasonable risk to health. Under section 1416(b), at the same time it grants an exemption the State is to prescribe a compliance schedule and a schedule for implementation of any required interim control measures. For exemptions resulting from a NPDWR promulgated after June 19, 1986, the system's final compliance date must be within 12 months of issuance of the exemption. However, the State may extend the final compliance date for up to three years if the public water system

shows that capital improvements to meet the MCL or treatment technique requirement cannot be completed within the exemption period and if the system needs financial assistance for the improvements, it has an agreement to obtain this assistance or the system has an enforceable agreement to become part of a regional public water system. For systems that have 500 or fewer service connections that need financial assistance to comply with the MCLs, the State may renew the exemption for additional two-year periods if the system is taking all practicable steps to comply.

#### C. Primacy

As indicated above, States, territories, and Indian Tribes may assume primary enforcement responsibility (primacy) for public water systems under Section 1413 of the SDWA. To date, 54 States and territories have primacy. To assume or retain primacy, States, territories, or Indian Tribes need not adopt the MCLGs but must adopt, among other things, NPDWRs (i.e., MCLs, monitoring, analytical, and reporting requirements) that are no less stringent than those EPA promulgates.

#### D. Monitoring, Quality Control, and Records

Under section 1401(1)(D) of the Act, NPDWRs are to contain "criteria and procedures to assure a supply of drinking water which dependably complies with such maximum contaminant levels; including quality control and testing procedures to insure compliance with such levels \* \* \*." In addition, section 1445 states that, "every person who is a supplier of water \* \* \* shall establish and maintain such records, make such reports, conduct such monitoring and provide such information as the Administrator may reasonably require by regulation to assist him in establishing regulations, \* \* \* in evaluating the health risks of unregulated contaminants or in advising the public of such risks." Section 1445 also requires EPA to promulgate regulations requiring every public water system to conduct a monitoring program for contaminants for which there is not an associated MCLG and MCL (i.e., unregulated contaminants).

#### E. Public Water Systems

Public water systems are defined in section 1401 of the Act as those systems which provide piped water for human consumption and have at least 15 connections or regularly serve at least 25 people. By regulation EPA has divided public water systems into

community; non-transient, non-community; and non-community water systems. Community water systems serve at least 15 service connections used by year-round residents or regularly serve at least 25 year-round residents (40 CFR 141.2). Non-transient, non-community water systems regularly serve at least 25 of the same people over six months of the year. Schools and factories which serve water to 25 or more of the same people for six or more months of the year are non-transient, non-community water systems. Transient non-community systems, by definition, are all other water systems. Transient non-community systems may include, for example, restaurants, gas stations, campgrounds and churches, among others.

#### F. Public Notification

Section 1414(c) of the Act requires the owner or operator of a public water system which does not comply with an applicable maximum contaminant level or treatment technique, testing procedure, or section 1445(a) (unregulated contaminant) monitoring requirements to give notice to the persons served by the system. Notice must be given if a variance or exemption is in effect or the system fails to comply with a compliance schedule resulting from a variance or exemption. Section 1445(a)(5) also requires public water systems to notify consumers and the EPA of the availability of the analytical results of the monitoring for unregulated contaminants. EPA's public notification regulations are codified at 40 CFR 141.32. Those regulations were amended by EPA on October 28, 1987 (52 FR 41534).

#### G. Secondary MCLs (SMCLs)

Section 1412(c) of the SDWA also authorizes EPA to promulgate National Secondary Drinking Water Regulations (NSDWRs). A NSDWR is defined in section 1401(2) as "a regulation which applies to public water systems and which specifies the maximum contaminant levels which, in the judgment of the Administrator, are requisite to protect the public welfare." The NSDWR "may apply to any contaminant in drinking water which may adversely affect the odor or appearance of such water and consequently may cause a substantial number of persons served by the public water systems providing such water to discontinue its use, or which may otherwise adversely affect the public welfare." NSDWRs are not federally enforceable but instead offer additional guidance to water systems and States



based upon odor, aesthetics, and appearance. Secondary Maximum Contaminant Levels (SMCLs) were established in 1979 for 12 contaminants (44 FR 42196, July 19, 1979) and in 1986 for fluoride (51 FR 11396, April 2, 1986).

### III. Establishing MCLGs

#### A. Background

In the 1986 Amendments to the Safe Drinking Water Act, Congress revised the Act to require that MCLGs and MCLs be proposed and promulgated simultaneously (SDWA Section 1412(a)(3)). This change streamlined development of drinking water standards by combining two steps in the regulation development process. Section 1412(a)(2) renamed Recommended Maximum Contaminant Levels (RMCLs) as Maximum Contaminant Level Goals (MCLGs).

To ensure compliance with the provision that MCLGs and MCLs be proposed and promulgated simultaneously and to ensure that adequate opportunity exists for public comment on these proposed standards, EPA is repropoing as MCLGs most of the RMCLs proposed in the November 1985 Federal Register Notice. In addition, MCLGs for several substances not listed in the November 1985 notice are also proposed.

Most of the MCLGs are being repropoed at essentially the same level as proposed in November 1985. However, the MCLGs for four contaminants are lower and four are higher than previously proposed. Two MCLGs are proposed for the first time. Where EPA is proposing MCLGs which differ from the previously proposed RMCLs, the changes result from public comments and/or additional data developed since the November, 1985 proposal. In these cases, the technical basis for these changes are explained in the discussion of the relevant contaminants.

Section 1412(b)(1) of the SDWA directs EPA to publish MCLGs and promulgate NPDWRs for nine contaminants by June 19, 1987 and 40 additional contaminants by June 19, 1988. The Agency published MCLGs and promulgated NPDWRs for eight VOCs and fluoride by June 19, 1987 (see 52 FR 25690, 51 FR 11396 and 50 FR 47142). This notice proposes MCLGs and NPDWRs for 38 additional compounds. Lead and copper MCLGs and NPDWRs, also proposed in November 1985, were repropoed for public comment in August, 1988 (53 FR 31516, August 18, 1988). The Agency also proposed rules for Filtration and Disinfection of Surface Water and Total Coliforms, on

November 3, 1987 (53 FR 42178 and 42224, respectively).

#### B. Procedure for Setting MCLGs

A detailed discussion of how EPA sets MCLGs is found in the November, 1985 proposal (50 FR 46944-46949). In summary, EPA uses a three category approach to set MCLGs (see Table 1). For those chemicals in Category I (strong evidence of carcinogenicity), EPA sets the MCLGs at zero. MCLGs for Category II chemicals (equivocal evidence of carcinogenicity) are set based upon non-carcinogenic data [the Drinking Water Equivalent Level (DWEL)] (see below). The DWEL is divided by an additional uncertainty factor to account for the potential carcinogenic risk. Alternatively the MCLG for a contaminant in Category II may be based upon lifetime carcinogenic risk calculations if a DWEL is not available. MCLGs for Category III chemicals (inadequate or no evidence of carcinogenicity) are set based upon the DWEL.

Table 1.—Three Category Approach to Set MCLGs

Category I:
Strong evidence of carcinogenicity
• EPA Group A or Group B
Category II:
Equivocal evidence of carcinogenicity
• EPA Group C
Category III:
Inadequate or no evidence of carcinogenicity
• EPA Group D or Group E

#### 1. Setting MCLGs for Category I Contaminants

Because there is no demonstrated threshold for carcinogenic health effects, EPA sets MCLGs for known (EPA group A) and probable (EPA group B) human carcinogens at zero. EPA has received a request from Multinational Business Services, Inc. ("MBS") to reconsider the Agency's policy of establishing MCLGs of zero for carcinogens and instead establish MCLGs for carcinogenic contaminants at calculated negligible risk levels. EPA considered adopting finite, risk-based MCLGs when it promulgated MCLGs for five carcinogenic volatile organic chemicals. EPA decided that, given the nonthreshold nature of carcinogenic effects, the zero MCLG option best fulfilled the mandate of the SDWA to establish MCLGs "at the level at which no known or anticipated adverse effects on the health of persons occur and which allows an adequate margin of safety." (See 49 FR 24347-24348, June 12, 1984, and 50 FR 46895-46896, November

13, 1985.) The decision by the Agency was upheld in *Natural Resources Defense Council v. Thomas*, 824 F.2d 1211 (D.C. Cir., 1987). For the reasons described previously, EPA believes at this time that it is appropriate to set MCLGs for known or probable carcinogens at zero. However, the Agency has included the request submitted by MBS in the record for this rulemaking. The Agency intends to fully address that submission and any related comments when final regulations are promulgated.

MBS also contended that the recent decision by the U.S. Court of Appeals for the District of Columbia Circuit in *Natural Resources Defense Council v. EPA*, 824 F.2d 1146 (1987) ("*Vinyl Chloride*"), which construed the Agency's duties under section 112 of the Clean Air Act, also applies to the establishment of MCLGs under the SDWA. The Agency does not believe that the court's analysis in *Vinyl Chloride* must be applied to the setting of MCLGs. That decision construed the specific language of section 112 of the Clean Air Act and the legislative history of that provision. Section 1412 of the SDWA differs from section 112 of the Clean Air Act both in terms of its language and legislative history. Furthermore, the role of the MCLG as a non-enforceable health goal, the first step in the process of determining the enforceable MCL, is unique to the SDWA. In light of the distinctions between section 112 of the Clean Air Act and section 1412 of the SDWA, the Agency does not believe that following the *Vinyl Chloride* analysis in setting MCLGs is either necessary or appropriate.

#### 2. Setting MCLGs for Categories II and III Contaminants

a. *Calculation of Drinking Water Equivalent Level.* For compounds which are not considered to have sufficient carcinogenic potential (i.e., those contaminants in Categories II and III), EPA calculates "no-effect" levels for chronic periods of exposure, including a margin of safety. This level, measured in milligrams per kilogram of body weight per day (mg/kg/day), is termed the Reference Dose (RfD) [formerly termed the Acceptable Daily Intake (ADI)] and is derived from a no-observed-adverse-effect level (NOAEL) or lowest-observed-adverse-effect-level (LOAEL) identified from a study in humans or animals. The RfD is an estimate (with uncertainty spanning perhaps an order of magnitude) of the daily exposure to the human population (including sensitive subgroups) that is likely to be



without appreciable risk of deleterious

effect during a lifetime. The RfD is calculated as follows:

$$RfD = \frac{(NOAEL \text{ or } LOAEL)}{(\text{Uncertainty Factors})} = \text{mg/kg body weight/day}$$

Uncertainty factors are used in order to estimate the comparable "no-effect" level for a large heterogeneous human population. The use of uncertainty factors accounts for intra- and interspecies variability, the small number of animals tested compared to the size of the exposed population,

sensitive subpopulations and the possibility of synergistic action between chemicals. Further discussion on the use of uncertainty factors may be found in the November, 1985 notice.

From the RfD, a Drinking Water Equivalent Level (DWEL) can be calculated. The DWEL represents a

media specific (i.e., drinking water) lifetime exposure at which noncarcinogenic health effects are not anticipated to occur.

The DWEL assumes 100% exposure from drinking water and is derived as follows:

$$DWEL = \frac{(RfD) \times (\text{Body Weight in kg})}{(\text{Drinking Water Volume in l/day})} = \text{mg/l}$$

where:

Body Weight = usually assumed to be 70-kg adult.

Drinking Water Volume = assumed to be 2 liters(l)/day for an adult.

b. *Relative Source Contribution.* To determine the MCLG for non-carcinogens, the contribution from other sources of exposure, including air and food, is taken into account. In the November 1985 proposal, EPA used the following procedure to evaluate the drinking water contribution relative to the total exposure to determine the MCLG.

If sufficient quantitative data were available on the relative contribution of total exposure from each source, the MCLG was calculated as follows (Note: this equation is conceptual in nature; i.e., the units do not balance as written.):

$MCLG = DWEL - \text{contribution from food} - \text{contribution from air}$

The inorganics have been well studied in FDA market-basket studies and other surveys. Consequently, sufficient quantitative data are generally available for inorganic chemicals.

If sufficient quantitative data were not available on air and food exposure the MCLG was calculated based on the drinking water contribution to the DWEL as follows:

$MCLG = (DWEL) \times (\% \text{ Drinking Water Contribution})$

For some contaminants, particularly the organic chemicals, data are generally not available. When data did not exist, EPA then estimated drinking water's contribution at 20 percent of total exposure. This value was considered protective and conservative

and accounts for the range of actual (but unknown) exposures from different sources. When adequate data were available or when data indicated that the relative source contribution differed from the 20 percent value, the standard estimate was then modified as appropriate.

To derive the MCLGs proposed in this notice, EPA utilized the general approach to assessing relative source contribution (RSC) as explained above and presented in more detail in the November 1985 notice. However, EPA has changed its policy regarding use of the RSC value as follows: Where data indicate drinking water exposure is between 80 and 100 percent of total exposure to a contaminant, EPA assigns a relative source contribution for drinking water of 80 percent. If data indicate that drinking water is responsible for a large part of total exposure to a chemical (i.e., 80 to 100 percent), EPA believes that it is prudent to allow for the contingency that exposure via air, food and other sources that may not be reflected in the available data is likely to occur. Utilizing the 80% "ceiling" for drinking water exposures ensures that the MCLG will be low enough to provide adequate protection for individuals whose total exposure to a contaminant is, due to dietary or other exposure, higher than currently indicated by available data. This approach, in effect, introduces an additional uncertainty factor and results in a lower MCLG. It ensures that the MCLG will result in no adverse effect with an adequate margin of safety.

EPA is considering utilizing a 20 percent floor in calculating future drinking water contributions. While EPA

did not rely on the 20 percent floor in this notice, EPA is considering assigning a 20 percent relative source contribution value for drinking water where data indicates that drinking water contributes between zero and 20 percent of the total exposure. In these situations, drinking water contributes a relatively small portion of total exposure to a contaminant. The use of RSC values below 20 percent will yield MCLG values which are lower than when a 20 percent value is used. However, because the majority of the total exposure is from other sources (i.e., the diet and air), EPA believes that the most appropriate course of action would be to try to reduce these other sources of exposure rather than to promulgate increasingly lower MCLGs to control the relatively small exposures contributed by drinking water. Use of a 20 percent RSC "floor" may therefore be appropriate in these situations. EPA requests public comment on this approach.

An additional issue regarding the RSC of drinking water contaminants is volatilization. There is evidence that some drinking water contaminants volatilize into the air. Since a volatilized contaminant can be inhaled, the relative contribution from drinking water may be higher than a value based exclusively on ingestion exposure. However, little information is available to characterize exposure due to the volatilization of drinking water contaminants. EPA is presently developing a model which attempts to characterize exposure due to the volatilization of individual contaminants (EPA, 1988, "Volatilization of Drinking Water Contaminants (Draft)"). EPA intends to publish this



model as soon as it is available. Currently inadequate data is available to estimate exposure to volatile contaminants from other routes of exposure. EPA therefore estimates that drinking water contributes 20 percent of the total exposure. EPA believes this

estimate is conservative and is adequately protective considering the additional exposure that may occur due to volatilization. When the volatilization model mentioned above is complete, the Agency will decide whether it can use it to derive MCLGs for VOCs.

Table 2 summarizes the approach EPA uses to estimate the relative source contribution for the purpose of calculating the MCLG. EPA requests public comment on this approach.

TABLE 2.—RELATIVE SOURCE CONTRIBUTION—PERCENT OF TOTAL EXPOSURE

	Drinking water exposure between 20 and 80 percent	Drinking water exposure between 80 and 100 percent	Drinking water exposure less than 20 percent
Adequate data are available .....	EPA uses actual data.....	EPA uses an 80 percent drinking water contribution.	EPA would use a 20 percent drinking water contribution <sup>1</sup>
Adequate data are not available .....		EPA uses a 20% drinking water contribution.	

<sup>1</sup> Not applicable to the MCLGs proposed in this notice.

### C. MCLG Value—Rounding Numbers

For each chemical in this notice, EPA determined the proposed MCLGs by rounding the final calculations to one significant figure. For example, if the calculations show a value of 0.44 mg/l, this is rounded to 0.4 mg/l. Conversely, a value of 0.45 mg/l is rounded to 0.5 mg/l. Values ending with 5 or more are consistently rounded up. EPA believes that rounding is appropriate because using more than one significant figure would imply a degree of precision that is not warranted given the large uncertainty factors (up to 1,000) which are generally used in deriving the MCLGs.

### D. Summary of Proposed MCLGs

For most of the contaminants for which MCLGs are proposed in this notice, the Agency is proposing MCLGs which are essentially the same as those proposed in the November, 1985 proposal. For these contaminants, the details of the MCLG calculations, including the RfD, the uncertainty factor, the DWEL and the RSC factor are discussed in the November, 1985 notice. Comments submitted on the RMCLs of the earlier proposal have been considered in preparing the current MCLG proposal, and resubmission is not necessary unless new information is available. The Agency's initial response to previously submitted comments are summarized below. EPA will prepare a final Comment/Response document when the rule is promulgated.

EPA solicits comments on all contaminants particularly those MCLGs which were revised from the 1985 RMCLs. EPA also solicits comments on MCLGs proposed for the first time in this notice.

EPA is reproposing essentially the same MCLG values for the following contaminants (some levels are slightly different from those presented in the November 1985 proposal because the values have been rounded to one significant figure):

#### Inorganic Chemicals

Asbestos	Nitrate
Cadmium	Nitrite
Chromium	Selenium

#### Synthetic Organic Chemicals

Acrylamide	Ethylbenzene
Alachlor	Ethylene dibromide
Aldicarb	Heptachlor
Aldicarb sulfoxide	Heptachlor epoxide
Carbofuran	Lindane
Chlordane	Methoxychlor
Dibromochloropropane	Pentachlorophenol
o-Dichlorobenzene	PCBs
cis-1,2-Dichloroethylene	Toluene
2,4-D	Toxaphene
Epichlorohydrin	2,4,5-TP

EPA is proposing new MCLG values for the following contaminants:

#### Inorganic Chemicals

Barium
Mercury
Total nitrate and nitrite

#### Synthetic Organic Chemicals

Aldicarb sulfone
Atrazine
1,2-Dichloropropane
Monochlorobenzene
Styrene
trans-1,2-Dichloroethylene
Xylene

Table 3 presents the proposed MCLGs for the inorganic chemicals and Table 4 presents the proposed MCLGs for the synthetic organic chemicals.

TABLE 3.—PROPOSED MCLGs FOR THE INORGANIC CHEMICALS

IOC	Proposed MCLG (mg/l)
Asbestos.....	7
(million fibers/liter (longer than 10 um).)	
Barium.....	5.
Cadmium.....	0.005.
Chromium.....	0.1.
Mercury.....	0.002.
Nitrate <sup>1</sup> .....	10 (as N).
Nitrite <sup>1</sup> .....	1 (as N).
Selenium.....	0.05.

<sup>1</sup> MCLG for total nitrate and nitrite=10 mg/l.

TABLE 4.—PROPOSED MCLGs FOR THE SYNTHETIC ORGANIC CHEMICALS

SOC	Proposed MCLG (mg/l)
Acrylamide.....	Zero.
Alachlor.....	Zero.
Aldicarb.....	0.01.
Aldicarb sulfoxide.....	0.01.
Aldicarb sulfone.....	0.04.
Atrazine.....	0.003.
Carbofuran.....	0.04.
Chlordane.....	Zero.
Dibromochloropropane.....	Zero.
o-Dichlorobenzene.....	0.6.
cis-1,2-Dichloroethylene.....	0.07.
trans-1,2-Dichloroethylene.....	0.1.
1,2-Dichloropropane.....	Zero.
2,4-D.....	0.07.
Epichlorohydrin.....	Zero.
Ethylbenzene.....	0.7.
Ethylene dibromide.....	Zero.
Heptachlor.....	Zero.
Heptachlor epoxide.....	Zero.
Lindane.....	0.0002.
Methoxychlor.....	0.4.
Monochlorobenzene.....	0.1.
PCBs.....	Zero.
Pentachlorophenol.....	0.2.
Styrene.....	<sup>1</sup> Zero/0.1.
Tetrachloroethylene.....	Zero.
Toluene.....	2.
Toxaphene.....	Zero.



TABLE 4.—PROPOSED MCLGS FOR THE SYNTHETIC ORGANIC CHEMICALS—Continued

SOC	Proposed MCLG (mg/l)
2,4,5-TP.....	0.05.
Xylenes (total).....	10.

<sup>1</sup> EPA proposes an MCLG of 0.1 mg/l based upon a Group C carcinogen classification and an MCLG of zero based on a group B<sub>2</sub> classification.

#### E. Summary of Comments

EPA received 117 comments on the proposed MCLGs in the November 1985 proposal. A brief summary of the comments dealing with general issues concerning the MCLGs follows. Many of these comments dealt with issues concerning individual chemicals and are summarized in the chemical-specific discussions below. EPA will respond to all public comments related to this rulemaking and any additional comments on this notice when the Agency promulgates a final rule.

#### 1. Comments on MCLGs and MCLs

Twelve individuals or organizations addressed the term "RMCL." Most of these commenters suggested that the name be changed to more accurately reflect its true meaning as a non-enforceable health goal. Others suggested that there is no need to establish both RMCLs and MCLs, and that the process should be integrated into a single, science-supported standard, the MCL.

One commenter discussed the use of uncertainty factors in setting MCLGs and MCLs. This commenter argued that MCLGs and MCLs should be calculated using smaller uncertainty factors.

**EPA response:** Under the SDWA Amendments of 1986, the term recommended maximum contaminant level (RMCL) has been changed to maximum contaminant level goal (MCLG). This change will help clarify the non-enforceable status of MCLGs. The SDWA requires promulgation of two distinct standards, the MCLG and the MCL. The 1986 Amendments require that MCLGs and MCLs be proposed and promulgated simultaneously.

EPA believes the uncertainty factors utilized in deriving the proposed MCLGs will ensure that the uncertainties noted below are adequately taken into account when MCLGs are set. The use of uncertainty factors represents EPA's best toxicology judgments considering the quality of the available data. These judgments are based upon procedures generally accepted in the scientific community. The MCLGs are health goals

set at levels to prevent adverse health effects with an adequate margin of safety. This safety margin must be sufficient to account for data uncertainties, extrapolation from animal to human data, and other factors. The Agency does not believe that the use of smaller uncertainty factors will ensure that the MCLGs adequately protect against adverse health effects with an adequate margin of safety.

#### 2. Comments on the Definition of Community Water Systems

Nine individuals or organizations provided comments regarding EPA's concerns about long-term exposure in non-community water systems that serve non-transient populations, such as schools and factories. Some commenters believed that the definitions of community and non-community public water systems should be unchanged. Other commenters felt that non-transient, non-community water systems should meet the MCLs applicable to community water systems.

**EPA response:** EPA promulgated a definition of "non-transient, non-community water system" (52 FR 25690, July 8, 1987; 40 CFR 141.2). EPA addressed comments submitted on this issue in the July 8 notice. EPA agrees with the commenters that non-transient, non-community water systems should be required to meet the same MCLs as community water systems since the chronic health risks to consumers in non-transient, non-community systems are similar to those in community water systems. Consequently, the MCLs promulgated in this rulemaking will apply to all community water systems and non-transient, non-community water systems.

#### 3. Comments on Selection of Contaminants for Regulation

Twenty-five commenters addressed EPA's approach to selecting contaminants for regulation. Under this approach, EPA establishes MCLGs and MCLs for substances that may present a drinking water health concern. Most commenters supported this approach. Several commenters disagreed with this approach and felt that EPA should only regulate when contaminants (1) pose significant adverse health effects, (2) are actually or likely to be present in drinking water, and (3) are detectable by available analytical techniques.

**EPA response:** Since the ANPRM and proposal in November, 1985, the SDWA was amended in 1986, and EPA is now mandated to set MCLGs and MCLs or treatment techniques for all of the contaminants referenced in § 1412(b)(1), except for seven chemicals which may

be substituted out of the list (see 52 FR 25720).

#### 4. Comments on Selection of Specific Contaminants for Regulation

Fifteen individuals or organizations submitted comments concerning the selection of specific contaminants for regulation. Several commenters discussed the lack of human health data for these contaminants in drinking water. One commenter stated that MCLGs and MCLs should not be set for synthetic organic chemicals since insufficient health effects data exists to evaluate these chemicals.

**EPA response:** As noted above, although EPA asked for public comments on which contaminants to regulate, the SDWA now specifies 83 contaminants which must be regulated by June 19, 1989. Under the Act, EPA has the discretion to substitute for seven of these compounds. On January 22, 1987 (53 FR 1892) EPA published its list of seven substitutes. EPA agrees that human health data for contaminants of concern are often limited. However, EPA does not agree that there are insufficient health effects data to justify regulating the organic chemicals. Available health effects data indicate that these chemicals can cause adverse health effects under certain conditions. The MCLGs are proposed at levels to prevent these effects with an adequate margin of safety. The SDWA requires EPA to regulate synthetic organic chemicals covered in this notice.

#### 5. Comments on Procedures for Calculating MCLGs

Twenty-two commenters provided comments on the procedure for calculating MCLGs. A few commenters stated that the term Acceptable Daily Intake (ADI) was confusing and suggested that EPA derive only a single number (the MCLG).

**EPA response:** EPA has substituted the term Reference Dose (RfD) for ADI. EPA believes that the derivation of the RfD value is an important step in determining and explaining the level of a contaminant which meets the statutory standard for MCLGs. (See the July 8, 1987 Federal Register Notice for discussion of calculating the MCLG.)

#### 6. Comments on Three-Category Approach for Setting MCLGs

Twenty-seven individuals or organizations discussed the three-category approach for setting MCLGs, as presented in Table 1 above. The majority of commenters endorsed this approach. Several commenters criticized the Agency's policy of setting the MCLG



at zero for known or probable human carcinogens.

**EPA response:** EPA believes setting MCLGs for known or probable human carcinogens at zero is consistent with the statutory directive to set MCLGs at the level at which no known or anticipated adverse effects on the health of persons occur and which provide for an adequate margin of safety. The U.S. Court of Appeals for the D.C. Circuit has upheld this approach in *NRDC v. Thomas*, 824 F.2d 1211 (D.C. Cir. 1987). As discussed previously, the Agency continues to believe that MCLGs of zero are consistent with the statutory directive.

#### 7. Comments on Monitoring and Reporting Requirements

Thirteen commenters discussed monitoring and reporting requirements for the regulated contaminants. Several commenters felt that each State should establish its own public notification and monitoring requirements and maintain all responsibility for issuing variances. One commenter noted that the States strongly support maximum State discretion in establishing monitoring requirements, particularly for synthetic organic chemicals.

A number of commenters discussed the three-tiered monitoring scheme which varies monitoring requirements based upon the occurrence and health effects of the specific contaminants. Most commenters expressed support for this monitoring approach and the resulting flexibility. Two commenters were concerned that the guidelines for each tier will not have enough flexibility resulting in small systems undertaking costly monitoring programs which are not affordable.

**EPA response:** The SDWA mandates that EPA establish MCLGs/MCLs, public notification, monitoring and variance requirements (among others) while States may implement and enforce these requirements. The monitoring requirements for this regulation propose a phased-in sampling requirement based on system size and reduced monitoring frequency for small systems. This approach would reduce the small system economic burden of monitoring. Furthermore, today's proposed rule allows the State flexibility in requiring initial monitoring for pesticides and PCBs based upon a vulnerability assessment. The proposed repeat monitoring frequency for these contaminants is also dependent upon the system's vulnerability and whether pesticides or PCBs are detected in initial sampling results.

#### 8. Comments on Financial Considerations

Six individuals or organizations discussed financial considerations in developing regulations. Several commenters stated that national drinking water standards (including the monitoring requirements) should be flexible and cost-effective.

**EPA response:** Under the SDWA, MCLs are applicable nationwide and apply to all systems, except where a public water supply obtains a variance or exemption under the Act. EPA does take costs into consideration in developing NPDWRs and the Agency agrees that cost effectiveness considerations should be taken into account. In terms of compliance monitoring, EPA agrees that the monitoring requirements should be tailored to local conditions and is proposing monitoring requirements which allow States to determine which systems must monitor based on a vulnerability assessment.

#### F. Proposed MCLGs for Inorganic Chemicals

1. *Asbestos.* EPA proposed an MCLG of 7.1 million fibers/liter for asbestos fibers exceeding 10  $\mu$ m in length in November 1985. That proposal was based upon evidence of occurrence of benign polyps in male rats following oral administration of intermediate (> 10  $\mu$ m range chrysotile asbestos. EPA also requested comment on the option of not proposing a primary regulation for asbestos due to the inconclusive nature of the health data. EPA has reexamined both options and has decided to repropose an MCLG of 7 million long fibers/liter (rounded off from 7.1 million) since sufficient health and occurrence data exist to justify a national regulation and the 1986 SDWA Amendments require the Agency to regulate this contaminant.

EPA has classified asbestos as a Group A, known human carcinogen, based upon human and animal evidence that inhaled asbestos is associated with lung tumors. However, EPA has not proposed an MCLG for asbestos based upon this classification, since the evidence for the association between ingested asbestos and cancer is limited (see discussion at 50 FR 46961). Instead, EPA has proposed an asbestos MCLG considering the chemical for drinking water purposes as if it were in Group C, based on the limited evidence of carcinogenic effects via ingestion.

EPA has considered whether inhalation exposure to indoor airborne asbestos from the water could present a health concern. EPA examined this issue

and based upon available data has concluded that the risk of this route of exposure is not significant. This is supported by a recent study from the New York State Department of Health (1986) (Investigation of Indoor Airborne Asbestos, Woodstock, New York, 1986). This is considered to be a worst case example since the drinking water was very corrosive resulting in severe degradation of the water system's asbestos-cement (A/C) pipe. Levels of asbestos were measured in excess of 300 million fibers per liter. Levels of asbestos in air were found not to be significantly different than background levels. Also, the levels in drinking water from corrosion of A/C pipe will be controlled in some systems by the corrosion control treatment technique regulation for lead and copper currently being developed by EPA.

On January 29, 1986, EPA proposed a rule under Section 6 of the Toxic Substances Control Act (TSCA) to ban the manufacture of certain asbestos products, including A/C pipe, and to phase out others. The TSCA proposal does not impact the use of currently installed A/C pipe. EPA recommends that water suppliers adopt corrosion control strategies to minimize corrosion of A/C piping material.

**Public comments:** A total of 23 individuals or organizations commented on the MCLG proposal for asbestos. A number of commenters stated that it was not appropriate to set an MCLG for asbestos since there are inadequate data to establish that ingestion of asbestos fibers presents a health risk. Three commenters felt that since epidemiological studies have not shown a correlation between asbestos in drinking water and cancer and the only evidence of carcinogenicity of asbestos by ingestion is from the National Toxicology Program (NTP) bioassay, an MCLG should not be established.

Several commenters stated that it is not appropriate to set an MCLG for asbestos since there are inadequate occurrence data. They stated that the NTP bioassay indicated that only asbestos fibers longer than 10  $\mu$ m appear to be of health significance in drinking water and there are no data that indicate that fibers longer than 10  $\mu$ m occur in drinking water.

Additional commenters felt that an MCLG should not be established for asbestos, since analytical methods to measure low levels of asbestos are not available. One commenter agreed that it was appropriate to set an MCLG for asbestos but expressed concern over the expense involved in monitoring for asbestos. Another commenter felt that



imprecise analytical results can only justify an MCLG of one significant figure. One commenter stated that the EPA did not consider the interactive effects observed in the NTP bioassay.

**EPA response:** EPA recognizes that the evidence of the health effects of ingested asbestos is limited. There was an increased incidence of benign polyps in male rats following ingestion of intermediate (>10  $\mu$ m in length) range chrysotile asbestos. However, EPA believes that there is a sufficient basis to justify regulating asbestos for the reasons outlined in the November 13, 1985, notice. Furthermore, the 1986 SDWA Amendments direct EPA to regulate asbestos.

EPA believes that sufficient occurrence data exist to warrant an MCLG for asbestos, since asbestos entering water supplies from asbestos/cement pipe is common where corrosive water is being used. While EPA agrees that the great majority of the asbestos fibers found in ground and surface waters are less than 10  $\mu$ m in length, available data indicate that a small percentage of fibers are greater than 10  $\mu$ m in length.

Under the SDWA, the availability of analytical methods is not a prerequisite to the establishment of an MCLG for a contaminant. Rather, that availability impacts on whether EPA promulgates an MCL or treatment technique as the enforceable standard (see sections IV and VI for a discussion of analytical methods and monitoring requirements for asbestos proposed in this notice).

EPA is proposing that only vulnerable systems monitor for asbestos, based upon a vulnerability determination by the State. This should significantly reduce the costs of monitoring.

EPA agrees that this MCLG should only be one significant figure and is repropose an MCLG of 7 million fibers/liter for asbestos fibers exceeding 10  $\mu$ m in length.

Regarding the comment on interactive effects, the NTP bioassay which studied rats exposed to 1,2-dimethyl-hydrazine dihydrochloride (DMH) and DMH with intermediate range chrysotile asbestos did not appear to significantly affect the carcinogenic potential of DMH, neither increasing or decreasing biologically important neoplasms.

2. **Barium.** EPA proposed an MCLG of 1.5 mg/l for barium in the November 1985 proposal on the basis of a study showing that chronic exposure to barium resulted in hypertension in rats (Perry, H.M., Kopp, S.J., Erlanger, M.W., Perry, E.F. 1983. "Cardiovascular Effects of Chronic Barium Ingestion." In: Hemphill, D.D., ed., *Trace Substances in Environmental Health—XVII*.

Proceedings of University of Missouri's 17th Annual Conference on Trace Substances in Environmental Health. Columbia, MO: University of Missouri Press). The 1985 notice also described the results of an epidemiology study which found that male and female adults consuming drinking water containing high levels of barium (7.3 mg/l) for more than ten years did not manifest significant differences in mean systolic/diastolic blood pressures (Brenniman, G.R., Kojola, W.H., Levy, P.S., Carnow, B.W., Namekata, T. 1981. "High Barium Levels in Public Drinking Water and Its Association with Elevated Blood Pressure." *Arch. Environ. Health*. 36(1):28-32; and see also Brenniman, G.R., Levy, P.S. 1984. "Epidemiological Study of Barium in Illinois Drinking Water Supplies.") While the Agency proposed an MCLG of 1.5 mg/l, EPA also solicited comment on whether the MCLG for barium should be based upon a chronic suggested no-adverse-response level (SNARL) of 4.7 mg/l derived by the National Academy of Science (NAS) (Drinking Water and Health, 1982. Vol. IV). EPA noted some concerns about the Perry and Brenniman studies as well as the SNARL derived by the NAS. Because of these questions, EPA believed that further study was appropriate and the Agency instituted a human study subsequent to the 1985 notice that examined the effect of barium in drinking water on blood pressure (Wones *et al.*, 1987, "Lack of Effect of Drinking Water Barium on Cardiovascular Risk Factors," University of Cincinnati College of Medicine, Cincinnati, OH, manuscript in preparation). After reevaluating the available data in light of the human study, EPA is repropose an MCLG of 5 mg/l for barium.

In the Wones study, eleven healthy men were enrolled in a 10-week dose-response protocol in which diet was controlled, other aspects of lifestyle known to affect cardiac risk factors were controlled, and the barium content of the drinking water (1.5 l/day) was varied from 0 (first 2 weeks) to 5 mg/l (next 4 weeks) to 10 mg/l (last 4 weeks). Multiple blood and urine samples, morning and evening blood pressures, and 48-hour electrocardiographic monitoring were performed at each dose of barium. There were no changes in morning or evening systolic or diastolic blood pressures, plasma cholesterol or lipoprotein or apolipoprotein levels, serum potassium or total calcium or glucose levels, or urine metanephrine levels. There were no arrhythmias related to barium exposure detected on electrocardiographic monitoring. In summary, drinking water barium at

levels of 5 and 10 mg/l did not appear to affect any of the cardiovascular risk factors studied in this project.

In light of the Wones *et al.* study, EPA believes that it is not appropriate to rely on the Perry *et al.* study in deriving the MCLG for barium. As the Agency noted in the preamble to the 1985 proposal, the rats in the study were exposed to minimal levels of trace metals, including calcium, and the lack of calcium may have contributed to the hypertensinogenic effects observed. Because the weight of the available human data (Wones *et al.*, 1987; Brenniman *et al.*, 1981; Brenniman and Levy, 1984) appear to contradict the results found in the Perry *et al.* rat study and thereby substantiate the Agency's concerns about that study, EPA is not relying on Perry *et al.* to derive the repropose MCLG.

The Wones *et al.* study failed to detect adverse effects at 10 mg/l. EPA has applied an uncertainty factor of 2 to derive an MCLG of 5 mg/l. EPA applied an uncertainty factor of 2 rather than a factor of 10 which would normally be applied with a human study with a NOAEL due to the fact that the study is corroborated by the results of other studies (i.e., the Brenniman *et al.*, 1981 study). EPA has not factored RSC into this number since the basis is a human study in which contribution from food and air is already taken into account. The repropose MCLG is supported by the results of Brenniman *et al.*, which failed to find adverse effects at slightly higher levels of 7.3 mg/l. Furthermore, the repropose MCLG is also consistent with the 4.7 mg/l value recommended by the NAS. EPA stated in the preamble to the 1985 proposal that 4.7 mg/l did not appear to be adequately protective of children. EPA now believes this is not the case since hypertension is an effect which is seen after many years of exposure and thus adults would be the population at risk for this effect.

EPA requests public comment on the approach used to set the MCLG for barium.

**Public Comments:** A total of 14 individuals or organizations submitted comments in response to the barium proposal.

One commenter raised two points regarding the health effects of barium: (1) barium may have beneficial effects on teeth and bone, and (2) EPA has incorrectly assumed that barium acts with no toxic threshold. One commenter argued that barium should not be classified as a heavy metal since the solubility of barium is adequate to allow excretion from the body and prevent cumulative toxicity.



One commenter stated that EPA should distinguish between salts of barium that are water soluble (chloride, nitrate, bicarbonate) and those that are water insoluble (sulfate, phosphate, carbonate). Two commenters expressed support for the proposed MCLG of 1.5 mg/l for barium, but most commenters disagreed with the proposed MCLG, arguing that it is unduly restrictive and should be higher. Reasons cited in support of this argument included the following: no information is presented to indicate barium occurs in public water systems at concentrations of 4.7 to 7.0 mg/l, so barium should not be regulated; there is no evidence that barium bioaccumulates, so there is no reason to expect cumulative damage; available epidemiological studies indicate that barium-containing water does not cause hypertension or cardiovascular problems; and establishment of a stringent MCLG will impose considerable cost of compliance without significant health benefits.

One commenter stated that the MCL should be retained at the present level of 1.0 mg/l until it can be proven conclusively that the proposed new level (1.5 mg/l) will not have hypertensinogenic or cardiotoxic effects. A number of commenters argued that it is not appropriate to base the MCLG for barium on the cardiovascular effects in rats reported by Perry *et al.* (1983). The reasons cited for this included the following: the results are based on intravenous administration, which is not an appropriate model for oral exposure; the effects have been demonstrated in only one study; and available human data are more relevant than animal data.

A number of commenters argued that the study by Brenniman *et al.* (1981) is adequate to establish that ingestion of water containing 7.3 mg/l of barium does not result in hypertension in humans, and that this should serve as the MCLG.

A number of commenters argued that the proposed MCLG for barium is unduly restrictive and that the chronic SNARL of 4.7 mg/l calculated by NAS is a more appropriate value. These commenters stated that the study by Brenniman *et al.* (1981) confirms that a concentration of 4.7 mg/l is not associated with adverse effects in humans, supporting the SNARL proposed by NAS.

**EPA Response:** EPA is aware of only one report [Sanders, H.J. 1971. *Chemical and Engineering News*, Feb. 25, 1980, page 38] showing beneficial effects of barium in animals, and EPA does not believe there is adequate evidence to conclude that barium is beneficial to

humans. EPA believes there is a threshold for health effects due to barium, and has set an MCLG based on the threshold value determined from several exposure studies.

Whether barium should be classified as a heavy metal is irrelevant to the establishment of an MCLG for this contaminant. The data clearly indicate that there are adverse health effects from exposure to barium and the MCLG is proposed at the level which will prevent those effects with an adequate margin of safety (see the Criteria Document on Barium).

While barium sulfate is poorly soluble, it is not insoluble, and EPA is aware of no data indicating that dissolved barium sulfate is not absorbed from the gastrointestinal tract. Moreover, insoluble barium salts may be partially solubilized in the acid environment of the stomach.

The commenter is incorrect in stating that barium does not occur in drinking water at concentrations of 4.7 to 7.0 mg/l. Barium is widely distributed in drinking water, and high levels do occur (Brenniman *et al.*, 1981; Brenniman and Levy, 1984).

All the available evidence indicates that barium is toxic to humans and therefore the issue of bioaccumulation in the body is irrelevant to the issue of what level will prevent those effects with an adequate margin of safety.

Although the commenter is correct in stating that the available epidemiological studies have not shown cardiovascular effects in humans, the available animal studies have demonstrated that hypertension is associated with exposure to barium. Furthermore, EPA has chosen the highest NOAEL from the available human studies in order to be protective against the occurrence of cardiovascular effects in the human population.

Derivation of an MCLG (a nonenforceable health goal) is based on consideration of health effects only, and does not consider the cost of compliance. The costs of compliance are considered in the derivation of the MCL (see Section IV).

Regarding retaining the MCL at 1.0 mg/l, EPA has determined that the repropoed MCLG of 5 mg/l will prevent adverse health effects (hypertension or cardiotoxic effects) with an adequate margin of safety. Thus, EPA does not agree with the commenter that the MCL should not be revised.

EPA is no longer relying solely on the Perry *et al.* study in determining the MCLG for barium, for the reasons explained above. However, EPA does not agree with the commenters that intravenous administration should not

be considered an appropriate model for oral administration. Intravenous administration is accepted by toxicologists as a valid testing method and may be used to approximate oral exposure. EPA agrees with the commenters that more than one study should be considered, if available, and that, in this case, the available human data are more relevant in determining the human health effects of barium exposure than the available animal data. Therefore, EPA is basing the repropoed MCLG on the weight of all the available evidence.

EPA has considered the Brenniman *et al.* study in determining that the repropoed MCLG adequately protects against adverse effects with an adequate margin of safety. The Agency has derived the MCLG based on a NOAEL of 10 mg/l derived from the Wones study. EPA does not believe that setting the MCLG at the NOAEL from the Brenniman study is appropriate, since that level does not include an uncertainty factor. The repropoed MCLG at 5 mg/l is very close to the NAS value of 4.7 mg/l, and EPA agrees with several commenters that this level is appropriate.

3. **Cadmium.** EPA proposed an MCLG of 0.005 mg/l for cadmium in the November 1985 proposal. This was based upon a DWEL of 0.018 mg/l, using renal dysfunction as an endpoint. EPA has classified cadmium in Group B1, probable human carcinogen, based upon evidence of lung cancer in humans due to inhalation exposure. However, EPA did not propose an MCLG for cadmium based upon this classification, since cadmium has not been shown to be carcinogenic through ingestion. Instead, EPA proposed an MCLG for cadmium based upon chronic toxicity data. Since there is inadequate dose-response data to characterize the presence or lack of a carcinogenic hazard, EPA is regulating cadmium for drinking water purposes as if it were in Group D. No new relevant data which changes the conclusions presented in the November 1985 notice have become available since its publication. EPA is therefore repropoing an MCLG of 0.005 mg/l for cadmium.

**Public comments:** Nine individuals or organizations commented on the MCLG proposal for cadmium. Five commenters agreed with the proposed MCLG, stating that there are adequate health effects and occurrence data and the value is in accord with the Suggested-No-Adverse-Response-Level (SNARL) proposed by the National Academy of Sciences (NAS). One commenter stated that the present MCL of 0.01 mg/l was fully



protective and should not be lowered. Another commenter felt that the assumption of 25 percent drinking water contribution in the MCLG calculation was too high. One commenter stated that EPA should regulate cadmium as a carcinogen.

**EPA response:** Regarding the lowering of the present MCL, EPA believes that this lower proposed MCLG is protective against adverse effects with an adequate margin of safety, for the reasons discussed in the November 1985 notice.

Regarding the 25 percent drinking water contribution for cadmium, EPA believes that this value is appropriate, since evidence indicates that absorption of cadmium is greater from water than from food. Thus, absorbed cadmium from the drinking water would contribute more than the 20% which EPA believes is appropriate to allocate to drinking water when data indicating relative source contribution are not available. Since actual data are not available with regard to cadmium, EPA believes that 25 percent is an appropriate estimate. The commenter provided no data to dispute this assumption. Furthermore, use of a 25% drinking water contribution yields a proposed MCLG which is consistent with the World Health Organization (WHO) recommendation of 0.005 mg/l for cadmium (Guidelines for Drinking Water Quality, Volume 1, WHO, Geneva, 1984). EPA has classified cadmium in Group B1, probable human carcinogen, based upon evidence of lung cancer from inhalation exposure. However, EPA is regulating cadmium for drinking water purposes as if it were in Group D, since there is no evidence of cancer from ingestion exposure.

**4. Chromium.** EPA proposed an MCLG of 0.12 mg/l for total chromium (Cr III and Cr VI) in the November 1985 proposal. EPA has classified chromium in Group A, known human carcinogen, based upon evidence that chromium VI causes lung cancer in humans and animals through inhalation exposure. EPA did not propose an MCOG for chromium based upon this classification, since chromium has not been shown to be carcinogenic through ingestion. Instead, EPA has proposed an MCLG for chromium based upon chronic toxicity data, since there is inadequate dose-response data to characterize the presence or lack of a carcinogenic hazard. EPA is regulating chromium for drinking water purposes as if it were in Group D. No new data which would change the conclusions presented in the November 1985 notice have become available since its publication. EPA is

therefore reproposing an MCLG of 0.1 mg/l for total chromium, rounded from the proposed value of 0.12 mg/l.

**Public comments:** Fourteen individuals or organizations commented on the MCLG proposal for chromium. One commenter stated that an MCLG should not be established for chromium since the data are inadequate to show that ingestion of chromium is associated with carcinogenicity. Another commenter felt that there should be no change in the existing chromium regulation.

Several commenters stated that the MCLG for chromium should be based on Cr VI instead of total chromium since (1) analytical methods exist for measuring Cr VI, (2) problems exist in applying an MCLG based on Cr VI to other valence states and (3) there is no evidence that Cr III is oxidized to Cr VI during drinking water disinfection.

Several commenters supported the proposed MCLG for chromium based on total chromium, while a number of commenters argued that separate MCLGs should be established for the two valence states of chromium, with main attention on Cr VI due to the greater toxicity of this valence state. Several commenters stated that the MCLG for Cr III can be much higher or even eliminated. One commenter stated that EPA should regulate chromium as a carcinogen. Another commenter felt EPA should have assumed a drinking water contribution of 20 percent, not 70 percent, since the contribution from food ranges from 50 percent to 99 percent.

**EPA response:** The MCLG for chromium is not based on carcinogenicity. While there is convincing evidence that occupational exposure (i.e., inhalation) to Cr VI may lead to cancer of the respiratory tract (NAS, 1977, *Drinking Water and Health*, Washington, DC: National Academy Press, pp. 241-246, August 1984.), EPA believes that the nature of the carcinogenic hazard via ingestion cannot at present be defined. In this regard, EPA's Cancer Risk Assessment Verification Endeavor (CRAVE), an intra-Agency group which examines the carcinogenic classification of chemicals, has concluded that there is adequate evidence to conclude that Cr VI is oncogenic via inhalation in humans (EPA Category A). However, CRAVE concluded that there was inadequate data to demonstrate that Cr VI has an oncogenic potential via ingestion. As there is inadequate evidence to suggest that chromium presents a carcinogenic risk via ingestion, EPA has based the proposed MCLG on a study which

examined the non-carcinogenic effects following oral administration of Cr VI.

EPA believes that the health data are adequate to justify setting an MCLG for chromium (see the November 1985 notice) and these data support the proposed MCLG, which is different than the interim chromium MCL. Furthermore, the SDWA Amendments mandate that EPA promulgate an MCL for this contaminant.

EPA agrees that analytical methods exist for measuring Cr VI. EPA believes it is proper to set an MCLG for total chromium based on the toxicology of Cr VI, since the two valence states are in dynamic equilibrium with the degree of oxidation depending on factors such as pH, dissolved oxygen, or presence of reducing agents. Information on the oxidation of Cr III to Cr VI developed by EPA's Office of Research and Development has shown Cr III to oxidize to Cr VI in the presence of chlorine at concentrations similar to those used to disinfect drinking water. Because of the potential for Cr III to be oxidized to Cr VI in drinking water, EPA believes it is appropriate to set an MCLG for total chromium.

EPA agrees that Cr III is of low toxicological concern and thus has based the MCLG on the toxicity of Cr VI. However, EPA does not agree that separate MCLGs should be set for the two valence states of chromium since there is the potential for Cr III to be converted to Cr VI in drinking water systems (as discussed above) and separate MCLGs would not consider this conversion potential.

EPA agrees that food normally contributes over 50 percent of the total dietary intake of chromium. However, in cases where chromium drinking water concentrations are at the MCLG of .1 mg/l, available data indicate that drinking water provides about 70 percent of the total daily chromium intake.

**5. Mercury.** EPA proposed an MCLG of 0.003 mg/l for mercury in the November 1985 proposal. Discussions of the human exposure data and the health effects of mercury are presented in the November 1985 proposal. This notice will discuss only new data and conclusions since publication of that notice, resulting in a repropose MCLG of 0.002 mg/l.

In the November 1985 proposal, EPA calculated a DWEL of 0.005 mg/l for mercury based upon a study in which rats were exposed to inorganic mercury salts for 8 to 12 weeks through subcutaneous injection [Druet et al. 1978, "Immune Type Glomerulonephritis Induced by Mercuric Chloride in the



Brown Norway Rat." *Ann. Immunol.* 129:777-792]. EPA used a NOAEL of 50 ug/kg/day (adjusted by 36 doses, 84 days), a factor of 0.739 to adjust for the percentage by weight of mercury in mercuric chloride, an uncertainty factor of 1,000 and an absorption factor of 10% to compensate for the difference in absorption between subcutaneous and oral exposure in the calculations. EPA based the DWEL and the MCLG on inorganic mercury since almost all mercury detected to date in drinking water is in this form.

The repropoed MCLG is based upon several short-term studies, including the Druet et al. study. EPA recently held a workshop on issues regarding the DWEL for mercury (EPA, Peer Review Workshop on Mercury Issues, Summary Report, October 26-27, 1987), and the conclusion was that since there are several short-term studies which used the same techniques and examined the same endpoints for mercury toxicity, each of these studies should be used as the basis for the DWEL. EPA calculated DWELs based upon the Druet et al. study in which exposure was via subcutaneous injection and two oral studies (Bernaudin et al. 1981).

"Inhalation or Ingestion of Organic or Inorganic Mercurials Produces Auto-Immune Disease in Rats." *Clin. Immunol. Immunopath.* 20:129-135; and Andres, P. 1984. "Brief Communications: IgA-IgG Binding in the Intestine of Brown-Norway Rats Ingesting Mercuric Chloride." *Clin. Immunol. Immunopath.* 30:488-494]. The DWEL based upon the Druet et al. study has been recalculated using the same calculations as in the November 1985 proposal except for the absorption factor. An absorption factor of 7 percent has been applied (versus the 10 percent which was used in the November 1985 proposal), since EPA believes that the current data indicates that 7 percent absorption more accurately represents the actual absorption of mercury. This absorption factor has been applied to account for the fact that the study was via subcutaneous injection instead of oral exposure. A DWEL of 0.011 mg/l was calculated based upon the Bernaudin et al. (1981) study; a DWEL of 0.022 mg/l was calculated based upon the Andres (1984) study and a DWEL of 0.008 mg/l was calculated based upon the Druet et al. study. The workshop on mercury concluded that 0.01 mg/l is an appropriate level for the DWEL based upon a review of all the data. In addition, this level is consistent with the DWEL calculated from the Bernaudin et al. (1981) study (this was rounded from 0.011 mg/l), which was the lowest

exposure dose from a study using oral exposure. EPA believes that studies using oral exposure are the most appropriate for drinking water purposes.

In November 1985, EPA proposed an MCLG of 0.003 mg/l, based upon a DWEL of 0.005 mg/l with data on human exposure factored in (0.0043 mg/day via the diet and 0.001 mg/day via air). The dietary data consisted primarily of organic mercury, i.e., the available information indicates that approximately 10 percent of the dietary intake is inorganic mercury, with the remaining 90 percent being organic mercury. Since the proposed MCLG was for inorganic mercury, EPA believes that it was incorrect to use the dietary data based on organic mercury in the calculation. Instead, EPA proposes to apply a 20 percent contribution factor from water. This is because the available data indicate that the drinking water contribution for inorganic mercury appears to be small, with dental amalgams probably being the major contributing factor to overall inorganic mercury exposure. However, the data are insufficient to evaluate the drinking water contribution in relation to other sources of exposure and thus EPA is applying a 20 percent drinking water contribution factor. Applying this factor results in an MCLG of 0.002 mg/l. The WHO guideline for total mercury is 0.001 mg/l for total mercury, which is in the same range as the proposed MCLG. EPA requests public comment on the approach used to set the MCLG for mercury.

**Public comments:** Eight individuals or organizations commented on the MCLG proposal for mercury. Two commenters supported the proposed MCLG for mercury. Three commenters argued that the proposed MCLG was inappropriate for the following reasons: (1) the uncertainty factor of 1,000 is too high, (2) the MCLG appears to have been based on the health effects of methyl mercury even though mercury in drinking water is usually in the inorganic form, (3) increasing the MCLG from the current MCL of 0.002 mg/l represents a very small change in the actual number and thus is not worth changing, and (4) there is no evidence that exposure occurs at a level of health concern.

Three commenters stated that EPA should not propose a separate MCLG for organic mercury compounds.

**EPA response:** An uncertainty factor of 1,000 is consistent with the NAS/ODW guidelines for use with a NOAEL from an animal study of less-than-lifetime duration. The MCLG was calculated based on health effects data on inorganic mercury, although

discussions of the toxicity of methyl mercury are included in the health criteria document.

The repropoed MCLG is at the same level (0.002 mg/l) as the current MCL, thus the comment concerning the change in the number is no longer relevant. EPA agrees that exposure to mercury through drinking water is generally very low and is generally below the levels of health concern, however, the potential for contamination exists. In addition, the 1986 Amendments to the SDWA require that an MCLG be set for mercury.

EPA agrees that a separate MCLG for organic mercury compounds should not be proposed because almost all mercury detected in drinking water is in the inorganic form.

**6. & 7. Nitrate and Nitrite.** EPA is proposing MCLGs for nitrate and nitrite that are identical to those in the November 1985 notice. These levels are 10 mg/l for nitrate and 1 mg/l for nitrite. (Note: In relation to drinking water, both nitrate and nitrite are commonly reported as nitrogen rather than as nitrate ( $\text{N}^{+3}$ ) or nitrite ( $\text{N}^{+2}$ ), per se; 10 mg/l of nitrate measured as nitrogen is equivalent to 45 mg/l nitrate.) The levels for nitrate and nitrite in this notice are stated in terms of these two compounds measured as nitrogen. EPA is also proposing an MCLG for total nitrate and nitrite of 10 mg/l, i.e., the sum of nitrate and nitrite may not exceed 10 mg/l. The MCLG for total nitrate and nitrite was not proposed in the November 1985 notice.

As described in the November 1985 proposal, the toxicity of nitrate in humans is due to the reduction of nitrate to nitrite in the human body. By reacting with hemoglobin, nitrite forms methemoglobin (met Hb) which will not transport oxygen to the tissues and thus can lead to asphyxia (i.e., blue babies) which, if sufficiently severe, can lead to death.

Regarding met Hb concentration levels which would be of concern, approximately 1% of circulating hemoglobin normally exists in the form of met Hb. Clinical symptoms occur at approximately 10 percent met Hb and a 50-75 percent level of met Hb results in death (NAS, 1972. Accumulation of Nitrate. National Research Council). Infants are the population most sensitive to the acutely toxic effects of nitrate and nitrite for a variety of reasons including greater water consumption/kg body weight, increased percent conversion of nitrate to nitrite and greater sensitivity of hemoglobin.

The current standard for nitrate is based on the previous Public Health Standard which, in turn, was based on a



literature survey (Walton, G. 1951. "Survey of Literature Relating to Infant Methemoglobinemia Due to Nitrate Contaminated Water." *Am. J. Pub. Health* 41:986-996). Walton observed that while serious methemoglobinemia, including death, was observed in infants exposed to high levels of nitrate, no cases were observed in infants exposed to 10 mg/l or less of nitrate (i.e., a NOAEL). The proposed standard is somewhat more stringent than the current MCL of 10 mg/l because it includes an MCL for nitrite (the more toxic form) and a joint standard of 10 mg/l for nitrate and nitrite.

EPA has reviewed the literature and concluded that an MCLG for nitrate of 10 mg/l is at a level at which there would be no adverse effects and which would allow an adequate margin of safety, because the available studies provide no evidence that any adverse health effect is seen at nitrate levels of 10 mg/l or below (EPA, Health Criteria Document on Nitrate/Nitrite). Further, this conclusion is supported by the separate analysis of others who have reviewed the current literature. With respect to methemoglobinemia and teratogenic effects and reproductive effects, Fan et al. (Fan, A.C., Willhite, C.C., Book, S.A. 1987. "Evaluation of the Nitrate Drinking Water Standard with Reference to Infant Methemoglobinemia and Potential Reproductive Toxicity." *Regulatory Toxicology and Pharmacology* 7:135-148) have recently reviewed the current literature and concluded that "10 ppm nitrate-nitrogen, adequately protects the very young from nitrate-induced toxicity, both pre- and postnatally."

When an MCLG is derived based on human data, EPA normally applies an uncertainty factor of 10 (for intraspecies variability) to ensure that the MCLG is adequately protective of the most sensitive members of the population. However, in this case, the Agency does not believe that an uncertainty factor is warranted because (1) the standard is designed to protect the most sensitive population (i.e., infants), (2) the studies covered a large number of subjects, and (3) the current standard has been in effect in this country for decades with no cases of methemoglobinemia reported from public drinking water supplies. Because there is considerably less data available on nitrite and due to the demonstrated direct toxicity of this chemical, EPA is applying an uncertainty factor of 10 to derive the proposed MCLG for nitrite of 1 mg/l.

EPA is also proposing a joint standard of 10 mg/l: the sum of the concentration of nitrate and nitrite cannot exceed 10

mg/l. Since both nitrate and nitrite result in met Hb, it is possible that the toxicity of nitrate and nitrite may be additive. EPA is proposing the joint nitrate/nitrite standard in order to account for the possible additive toxicity of these two chemicals and also to protect against the deterioration of the drinking water quality, since the presence of nitrite in water is indicative of water contaminated with sewage.

The combined standard does not supplant the individual standards for nitrate and nitrite. In summary, the following MCLGs are proposed: the concentration of nitrate shall not exceed 10 mg/l (as nitrogen), the concentration of nitrite shall not exceed 1 mg/l (as nitrogen), and the sum of the concentration of nitrate and nitrite shall not exceed 10 mg/l (as nitrogen).

**Science Advisory Board Comments:** The Science Advisory Board (SAB, 1987) commented on the proposed nitrate/nitrite standard based on a review of the Draft Health Criteria Document on Nitrate/Nitrite. A summary of the SAB comments and the EPA response follows.

a. The SAB concluded that "the Agency can appropriately set a proposed health advisory level on the basis of methemoglobin formation."

**EPA Response:** EPA agrees since the Agency believes that methemoglobin is the appropriate basis for the standard.

b. The SAB recommended that a more extensive analysis should be provided of Walton (1951) which was one of the bases of the standard.

**EPA Response:** As noted above, Walton (1951) was the basis for the Public Health Standard relied upon by EPA when it adopted the current 10 mg/l nitrate standard. In addition, substantial new information since the Walton study was considered in the EPA Nitrate/Nitrite Health Criteria Document (EPA, 1987). This information further supports EPA's conclusion that a 10 mg/l nitrate standard is protective.

c. The SAB recommended that EPA should place the total exposure to nitrate and nitrite (i.e., contributions from water, and diet, etc.) into better perspective.

**EPA Response:** EPA has analyzed nitrate/nitrite exposure through various pathways. That analysis is described in a document entitled "Estimated National Occurrence and Exposure to Nitrate/Nitrite in Public Drinking Water Supplies". Available information indicates that adults who consume nitrate at the proposed standard of 10 mg/l would receive approximately 50% of their nitrate from drinking water and 50% from the diet.

d. The SAB noted that the margin of safety (i.e., uncertainty factor) used by EPA may not be adequate to protect "sensitive members of the population, namely, infants with gastrointestinal disease."

**EPA Response:** EPA believes that the standard of 10 mg/l contains an adequate margin of safety to protect sensitive members of the population, namely, infants with gastrointestinal disease. This conclusion is supported by numerous analyses of the scientific literature. For example, both the World Health Organization (Guidelines for Drinking Water and Other Supporting Information, 1984, WHO, Geneva, pg. 128-134) and the Canadian Department of Health and Welfare (Guidelines for Canadian Drinking Water Quality, Supporting Documentation, 1978, pg. 419-431, Minister of Supplies and Services, Canada, 1980) concluded that infant methemoglobinemia has not been reported where drinking water contains less than 10 mg/l nitrate.

e. The SAB noted that there is a lack of data on the reproductive and developmental effects of nitrate and nitrite.

**EPA Response:** While EPA believes that more data should be generated regarding reproductive and developmental effects of nitrate/nitrite in drinking water, the Agency believes sufficient data exist to conclude that developmental and reproductive effects are not evident at the 10 mg/l drinking water standard. See Fan (1987) and the EPA Nitrate/Nitrite Health Criteria Document (EPA, 1987).

f. The SAB recommended that the Office of Drinking Water should set a single public health standard for the contribution from both nitrate and nitrite.

**EPA Response:** EPA agrees and proposes a combined nitrate/nitrite MCLG of 10 mg/l.

g. The SAB recommended that the Office of Drinking Water present a conclusion on the current knowledge of potential impacts of nitrosated materials in drinking water.

**EPA Response:** As discussed elsewhere in this section, EPA believes that there is not sufficient evidence to conclude that nitrosated materials in drinking water present a cancer risk.

**Public comments:** Sixteen individuals or organizations commented on the MCLG proposal for nitrate/nitrite. Six commenters supported the proposed MCLG of 10 mg/l for nitrate. Another commenter contended that no adverse health effects are seen until water levels exceed 45 mg/l, and another stated that no standard should be set because there



is no data indicating that nitrate occurs at levels associated with this health risk. However, several other commenters believed that the proposed MCLG is too high, and should be reduced to a lower value (in the range of 2 to 3 mg/l) because (1) the proposed MCLG includes no margin of safety and (2) nitrate may be metabolized into carcinogenic nitroso-compounds.

**EPA Response:** Regarding the statement on adverse effects of nitrate at levels above 45 mg/l, the commenter apparently has failed to recognize that 45 mg/l nitrate is equivalent to 10 mg/l nitrate expressed as nitrogen. Thus, the proposed MCLG for nitrate of 10 mg/l expressed as nitrogen is identical to 45 mg/l expressed as nitrate. EPA, therefore, agrees with the commenter that adverse effects would not be seen until levels of nitrate exceed 45 mg/l (expressed as nitrate) or 10 mg/l (expressed as nitrogen).

Nitrate concentrations of 10 mg/l or greater have been detected in over 800 small, rural ground water systems. Because health effects are associated with levels of nitrate in excess of 10 mg/l, EPA disagrees with the commenter who stated that there is no data which indicates that nitrate occurs at levels associated with health risk. Furthermore, the SDWA Amendments direct EPA to promulgate drinking water regulations for nitrate and nitrite.

Regarding the two comments which stated that the proposed MCLG is set at too high a level:

(1) As previously discussed, the proposed MCLG of 10 mg/l as nitrogen contains an adequate margin of safety, as EPA has found no evidence of any cases of any adverse health effect associated with the consumption of water with 10 mg/l or less of nitrate. This is based upon an extensive review of the literature (EPA, Health Criteria Document for Nitrate/Nitrite) and decades of experience with the current nitrate standard.

(2) EPA is well aware that nitrate and nitrite present the *theoretical* possibility of an oncogenic risk, since nitrate is reduced in the human body to yield nitrite, and under suitable conditions, nitrite can react with nitrosatable compounds to form oncogenic N-nitroso compounds. However, the evidence from human studies concerning the carcinogenicity of these compounds is inconclusive. There are several studies which show an association between nitrate and gastric cancer [Hartman, 1983, "Review: Putative Mutagens and Carcinogens in Food," *Environmental Mutagenesis* 5:111-121, as cited in *Case Studies in Ground Water Quality Protection*, prepared by R. Rajagopal et

al. University of Minnesota, Duluth]. However recent epidemiology studies do not show an association [Forman, D., Al-Dabbagh, S., Doll R. 1985, "Nitrates, Nitrites and Gastric Cancer in Great Britain." *Nature*. Vol. 313. pp. 620-625; and Al-Dabbagh, S., Forman, D., Bryson, D., Stratton, L., Doll, R. 1986, "Mortality of Nitrate Fertilizer Workers." *Brit. J. Ind. Med.* 43(8): 507-515]. Forman et al. (1985) correlated the incidence of gastric cancer with the levels of salivary nitrate and nitrite in humans. Salivary nitrate is a measure of total nitrate exposure and salivary nitrite is a measure of the levels of nitrite present in the stomach. The study found that there was an inverse correlation between gastric cancer and salivary levels of nitrate and nitrite, i.e., the higher the levels of salivary nitrate and nitrite, the lower the incidence of gastric cancer. In addition, Al Dabbagh et al. (1986) observed that, in fertilizer workers, the available data did not suggest that high nitrate exposure led to gastric cancer.

Therefore, EPA does not believe there is sufficient evidence to conclude at the present time that nitrate or nitrite present a potential cancer risk through drinking water exposure. Comment is requested on this issue.

(3) Several recent studies have addressed the question of possible relationship between nitrate and developmental effects. For example, Dorsch et al., 1984 (Dorsch M.L., McMichael, A.J., et al. Congenital malformations and maternal drinking water supply in rural South Australia: a case control study. *Am J. Epidemiology*. 1984. 119. pp. 473-486) have suggested that the consumption of nitrate in drinking water may present a developmental hazard. The recent study by Arbuckle et al., 1988 (Arbuckle, T.E., Sherman, G.J., et al. Water nitrates and CNS birth defects: a population-based case-control study, available to EPA as a preprint and subsequently published March, 1988 in *Arch. Env. Health*, V. 43, No. 2, pp. 162-167) does not support the conclusions of Dorsch et al. As previously stated, Fan et al. (1987), who reviewed the work of Dorsch et al., as well as significant other data, concluded that "10 ppm nitrate-nitrogen, adequately protects the very young from nitrate-induced toxicity, both pre- and postnatally."

EPA is requesting comment on this information regarding reported potential developmental effects of nitrate and whether the proposed MCLGs provide adequate protection. Specifically EPA requests comments on the margin of safety and its adequacy to protect the public from these other potential effects.

EPA is requesting comment on whether the MCLG should be lowered.

8. **Selenium.** EPA proposed an MCLG of 0.045 mg/l for selenium in the November 1985 proposal. No new data which change the conclusions presented in that notice have become available since its publication. EPA is therefore repropounding an MCLG of 0.05 mg/l for selenium (rounded from the proposed value of 0.045 mg/l). EPA is also requesting comment on alternative MCLGs of 0.02 mg/l and 0.1 mg/l for selenium, as discussed below.

In the November 1985 proposal EPA calculated a DWEL for selenium based upon a human study which examined selenium toxicity and deficiency effects in China [Yang et al. 1983, Endemic Selenium Intoxication of Humans in China. *Amer. Jour. Clin. Nutr.* 37:872-881]. EPA used a LOAEL of 3.20 mg/day and an uncertainty factor of 15 resulting in a DWEL of 0.106 mg/l. EPA stated in the 1985 preamble that an uncertainty factor of 10 would normally apply in this situation. However, that statement was incorrect, since the Agency normally uses an uncertainty factor of 100 when deriving the MCLG based on a LOAEL from a human study. The Agency believes that use of the usual uncertainty factor is not appropriate here since, as discussed in the 1985 proposal, selenium is an essential nutrient in humans. In cases such as this, the Agency evaluates evidence of a compound's essentiality in addition to evidence on its toxicological effects in determining the MCLG. The NAS has estimated an adequate and safe level for adults at 0.05 to 0.2 mg/l. Use of the larger uncertainty factor of 100, however, would result in a level below that considered safe and adequate by the NAS (0.05 mg/day) and therefore would not adequately protect against adverse effects that may result from selenium deficiency. EPA believes that the proposed MCLG adequately balances the potential deficiency and toxicity effects of selenium. Data on human exposure was then factored in (0.125 mg/day via the diet and 0 mg/day via air), resulting in an MCLG of 0.045 mg/l.

EPA is requesting public comment on whether it would be appropriate to use a relative source contribution factor of 20 percent, instead of factoring in actual human exposure data. EPA has used FDA Market Basket Surveys and other reports on selenium intake available in the literature to determine an average selenium dietary intake of 0.125 mg/day (See the Health Criteria Document for Selenium for the references on selenium intake). Since selenium intake varies



greatly depending on dietary exposures, EPA requests public comment on whether the above selenium dietary intake is representative of actual human consumption. If public comments determine these data to be nonrepresentative of actual human consumption, EPA would factor in a relative source contribution of 20 percent from drinking water, resulting in an MCLG of 0.02 mg/l. Although this level is slightly below the NAS' safe and adequate range (0.04 mg/day vs. the NAS' level of 0.05 mg/kg/day), EPA believes it is adequate to be protective against deficiency effects.

EPA's Science Advisory Board reviewed the MCLG for selenium and suggested that the DWEL be raised to 0.16 mg/l, based upon the same calculations as were used to set the proposed MCLG, except with the application of an uncertainty factor of 10 instead of 15. Use of this uncertainty factor would result in an MCLG of 0.1 mg/l. The basis of the SAB recommendation was as follows:

(1) In the Yang *et al.* study, the LOAEL was 3.2 mg/kg/day and no lower values have been reported.

(2) An upper limit of 0.2 mg/day (as cited in the NAS report) is not supported by any of the data.

(3) A daily intake of 0.214 mg/day (EPA's DWEL multiplied by 2 liters/day) is too close to the value needed for human nutrition and too far from the lowest value at which human symptoms occur.

(4) There is little or no evidence for proposed human health effects such as cancer or teratogenic effects. Selenium is not regarded as a human carcinogen.

(5) Uncertainty factors should reflect likely beneficial effects as well as harmful effects. There is limited evidence that selenium deficiency is related to cancer and perhaps cardiovascular disease.

Public comments are requested on this approach to setting the MCLG.

**Public comments:** Ten individuals or organizations commented on the MCLG proposal for selenium. Six commenters agreed with EPA's proposal of an MCLG of 0.045 mg/l for selenium. Reasons cited included the essentiality of selenium, its vital role in cell metabolism, the absence of acute human toxicity and its low occurrence. One commenter stated that when selenium is detected, interactions with other inorganics (e.g., arsenic, cadmium, mercury) should be considered.

Three commenters disagreed with the proposed MCLG for selenium. One commenter stated that since selenium is an essential trace element and inhibits tumors, an MCLG that is too low

actually increases the net risk of adverse health effects. The other commenter also felt that EPA was too conservative in calculating the MCLG and recommended using an uncertainty factor of 10 (resulting in an MCLG of 0.1 mg/l). A third commenter stated that EPA should use an uncertainty factor of 100 or more, since the MCLG is based on a LOAEL from a human study and since selenium is absorbed more efficiently from water than from food.

**EPA response:** EPA agrees with the SAB and the commenters that it is appropriate to consider the essentiality of selenium and the other factors cited in developing the MCLG. EPA agrees that interaction between inorganic chemicals is an important consideration. However, at the present time there is not enough known about these potentially complex interrelationships to be used directly in calculating the MCLG. EPA applies uncertainty factors in part to take into account possible synergistic effects.

EPA does not believe that the MCLG is proposed at too low a level nor that it would increase the net risk of adverse health effects such as tumors. The MCLG is set to protect against the potential toxic effects of selenium and EPA believes that this level balances the essentiality of selenium with the potential toxicity of the compound. It is unknown at what levels selenium may be protective against tumors in humans and thus EPA does not believe this consideration can be quantitatively factored into calculating the MCLG.

EPA agrees that the proposed MCLG represents a conservative approach. EPA's use of an uncertainty factor of 15 is consistent with the SDWA mandate that MCLGs be set at a level protective of human health with an adequate margin of safety. EPA is soliciting public comment on whether it may be appropriate to use an uncertainty factor of 10 with selenium. As discussed above, EPA believes an uncertainty factor of 100 or more cannot be justified due to the essentiality of selenium.

#### G. Proposed MCLGs for Synthetic Organic Chemicals

1. **Acrylamide.** EPA proposed an MCLG of zero in the November 1985 notice for acrylamide based on carcinogenic risk and discussed the health effects and exposure data for acrylamide in detail. No additional data which change the conclusions presented in that notice have become available since its publication. EPA is therefore repropounding an MCLG of zero for acrylamide.

**Public Comments:** A total of 12 individuals or groups commented on the

MCLG proposal for acrylamide. Two commenters stated that the DWEL for acrylamide should be 0.175 mg/l, based on a NOAEL of 0.5 mg/kg/day, as calculated in a study by Johnson *et al.* (1984), instead of the Burek *et al.* (1980) study in which a DWEL of 0.007 mg/l was calculated.

Several commenters stated that it is inappropriate to set the MCLG at zero for several reasons. These reasons included the assertions that: (1) The carcinogenicity data are weak and classification in Group B2 is inappropriate; (2) the available data indicate that there is little or no occurrence in drinking water, and EPA's estimate of the potential levels (0.0005 mg/l) is unrealistically high; (3) if acrylamide is a carcinogen, a risk of  $10^{-5}$  to  $10^{-6}$ , or 0.1 to 0.01 ug/l is reasonable for regulation; (4) there is no suitable analytical method; and (5) an MCLG of zero is inconsistent with its use in water treatment and the MCLG will have serious impacts for water treatment facilities.

**EPA Response:** EPA has reviewed the Johnson *et al.* (1984) study (Johnson, K., Gorzinski, S., Bodner, K., Campbell, R. 1984. "Acrylamide: A Two-Year Drinking Water Chronic Toxicity—Oncogenicity Study in Fischer 344 Rats." Dow Chemical Company), which describes the results of chronic drinking water exposure to acrylamide in rats. The Agency agrees with the commenter that, based upon the evaluation of behavior, food and water consumption, body/organ weight ratio and conventional light microscopy, the NOAEL would be identified as 0.5 mg/kg/day. However, the study by Burek *et al.* (1980) (Burek, J.D., Albee, R.R., Beyer, J.E., *et al.* 1980. "Subchronic Toxicity of Acrylamide Administered to Rats in the Drinking Water Followed by Up To 144 Days of Recovery." *J. Environ. Pathol. Toxicol.* 4:157-182), which identified a NOAEL of 0.2 mg/kg/day, indicates that electron microscopic examination of peripheral nerve is a more sensitive endpoint of acrylamide neurotoxicity than is light microscopy. Therefore, since the study by Johnson *et al.* (1984) does not measure the most sensitive endpoint, that study is not appropriate for derivation of a DWEL for acrylamide. In a subsequent study, Johnson *et al.* (1985) [Johnson, K., Beyer, J., Bell, J., Schuetz, D., Gorzinski, S. 1985. "Acrylamide: A Two-Year Drinking Water Chronic Toxicity—Oncogenicity Study in Fischer 344 Rats. Electron Microscopy Portion." Dow Chemical Company] reported electron microscopic observations made during serial sacrifices at 6, 12, 18 and 24 months.



These results also identify a NOAEL of 0.5 mg/kg/day, but only for data up to and including the 12-month sacrifice; the 18 and 24 month data were judged to be indeterminate. Thus, the Burek et al. (1980) data has been used to calculate a DWEL.

EPA believes it is appropriate to establish an MCLG for acrylamide at this time; the SDWA Amendments direct EPA to promulgate a national primary drinking water regulation for acrylamide. The Agency is proposing an MCLG of zero for the reasons stated in the November notice. With regard to the specific assertions by the commenters:

(1) EPA has reviewed the carcinogenicity data on acrylamide and has concluded that the B2 classification is appropriate, as the chemical tested positive in more than one species, in more than one strain in one of the species, and by more than one exposure route.

(2) Although there are few data on the occurrence of acrylamide in drinking water, there is the potential for exposure to acrylamide as a residual monomer from polyacrylamide which is used in water treatment. Under the current voluntary drinking water additives guidance program, the maximum acceptable level of acrylamide in polyacrylamide is 0.05 percent weight by weight and the use level as a flocculant is 1 ppm. Assuming that all of the residual monomer will remain in water during flocculation, this could yield a maximum of 0.0005 mg/l acrylamide in finished water. However, levels are likely to be well below 0.0005 mg/l because chemical reactions in water of trace residues would likely reduce the levels of acrylamide. Nonetheless, in light of the potential for occurrence and the health risks posed by this carcinogen and the mandates of the SDWA Amendments, EPA is proposing national primary drinking water regulations for this contaminant.

(3) EPA is proposing the MCLGs for carcinogens at zero, for the reasons outlined in the November 1985 notice and elsewhere in this notice. This approach has been upheld by the D.C. Circuit in *NRDC v. Thomas*, *supra*.

(4) EPA agrees that there is no suitable analytical method for acrylamide; however, the availability of analytical methods is not relevant to determining the MCLG, but was considered by EPA in proposing a treatment technique for acrylamide instead of an MCL.

(5) The MCLG is a non-enforceable health goal and therefore has no impact on the use of acrylamide in the water treatment process.

2. *Alachlor*. In the November 1985 proposal, EPA proposed an MCLG of zero for alachlor based on carcinogenicity (Group B2). A detailed discussion of the adverse health effects and occurrence of alachlor is presented in that notice. No new relevant data which change the conclusions presented in that notice have become available since its publication. Therefore, EPA is repropounding an MCLG of zero for alachlor.

**Public Comments:** Two commenters submitted comments on the proposed MCLG for alachlor. One commenter agreed with EPA's proposal for an MCLG of zero. Another commenter stated that it was inappropriate for EPA to set an MCLG for alachlor prior to the special review by EPA's Office of Pesticide Programs (OPP) and that the Office of Drinking Water (ODW) should follow OPP's lead. If EPA determines that an MCLG must be established, then the commenter felt that a zero level is inappropriate and a minimum value of 0.005 mg/l was recommended.

**EPA Response:** At the present time, OPP has completed three Position Documents (PD's) (1984, 1986 and 1987) on alachlor and completed the special review on this chemical. EPA believes there is sufficient information available to justify setting an MCLG for alachlor at the present time. OPP's special review contains OPP's regulatory options on alachlor based on the same toxicological data which ODW has used to set the proposed MCLG. EPA is proposing MCLGs for carcinogens at zero, for the reasons outlined in the November 1985 notice. Since alachlor has been classified in Group B2 (probable human carcinogen), EPA is repropounding the MCLG at zero, not at 0.005 mg/l as suggested by the commenter.

3, 4, and 5. *Aldicarb, Aldicarb sulfoxide, and Aldicarb sulfone*. In the November 1985 notice, EPA proposed an MCLG of 0.009 mg/l for total aldicarb residues (the parent compound as well as the sulfoxide and sulfone residues). Discussions of the human exposure data and the health effects of aldicarb and its metabolites are presented in the November 1985 proposal. This notice will discuss only the new data and conclusions that have been revised since publication of that notice.

In the November 1985 proposal, EPA calculated a DWEL for aldicarb based upon a study in which rats were administered aldicarb sulfoxide and aldicarb sulfone in the diet for periods of 3 to 6 months (C.S. Weil and C.P. Carpenter, 1968a and b. Temik sulfoxide, Temik sulfone. Results of Feeding in the Diet of Rats for Six Months and Dogs for Three Months.

Mellon Institute Report 31-141 and 31-142. EPA Pesticide Petition No. 9F0798). A NOAEL of 0.125 mg/kg/day was determined based upon a lack of significant decreases in cholinesterase activity for aldicarb sulfoxide. Applying an uncertainty factor of 100 and assuming consumption of 2 liters of water per day resulted in a DWEL of 0.04 mg/l (rounded from 0.044).

The MCLG in the November 1985 notice was proposed for total aldicarb, since the residues of aldicarb found most often in water samples are the sulfoxide and the sulfone. Toxicologically, the MCLG was calculated based upon studies on aldicarb sulfoxide since the sulfoxide is slightly more potent than the parent compound and significantly more potent than the sulfone as an inhibitor of cholinesterase.

In this notice, EPA is proposing separate MCLGs for each individual compound. EPA is proposing that the same study which was used as the basis for the MCLG in the November 1985 notice be used as the basis for the proposed MCLG for aldicarb and aldicarb sulfoxide. The MCLG for aldicarb is proposed at 0.01 mg/l and the MCLG for aldicarb sulfoxide is also proposed at 0.01 mg/l, rounded off from the value of 0.009 mg/l which was proposed in November. There is good evidence (based upon acute toxicity studies) that the toxicity of aldicarb is very similar to that of aldicarb sulfoxide. In addition, it is likely that the effects of the parent compound are due to the sulfoxide. Thus, EPA believes that the study used in the November 1985 notice is an appropriate basis for the MCLG for both aldicarb and aldicarb sulfoxide.

EPA is relying on the same study to set the MCLG for aldicarb sulfone as is used to set the proposed MCLGs for aldicarb and aldicarb sulfoxide. The data for aldicarb sulfone from this study indicated a NOAEL of 0.6 mg/kg/day based upon cholinesterase inhibition. Based on this NOAEL, a DWEL of 0.2 mg/l (rounded from 0.21 mg/l) and an MCLG of 0.04 mg/l was calculated for aldicarb sulfone.

EPA is requesting comment on whether a single MCLG could be set for total aldicarb residues. This MCLG could be set based upon the most toxic component of the mixture. In a short-term study [Mirro et al. 1982. "Aldicarb Sulfone: Aldicarb Sulfoxide, Twenty-nine Day Water Inclusion Study Rats." Mellon Inst. Report #45-18], a 1:1 mixture of aldicarb sulfoxide and aldicarb sulfone in the drinking water of young rats for 8-29 days resulted in a



statistically significant reduction in cholinesterase activity in brain, plasma and red blood cells in both sexes at 1.8 mg/kg/day and in red blood cells in males at 0.5 mg/kg/day at the end of the study period; however, no effects were noted at 0.12 mg/kg/day or below. This NOAEL, 0.12 mg/kg/day, is the same as that derived for aldicarb sulfoxide alone, although the intensity of cholinesterase inhibition with the 1:1 mixture at doses higher than 0.12 mg/

kg/day is lower than the level of inhibition noted at comparable doses of aldicarb sulfoxide alone. Thus, it appears that the effect levels for these compounds in a 1:1 mixture reflect the inhibitory activity of the aldicarb sulfoxide portion of the mixture. Thus, for mixtures of this chemical and its metabolites, there are data which support basing an MCLG for total aldicarb residues upon the most toxic component (i.e., aldicarb sulfoxide).

Thus, such an MCLG for "total aldicarb" would be set at 0.01 mg/l.

EPA is also requesting comment on whether an alternate approach could be used to set an MCLG for aldicarb mixtures. One approach could be to base the MCLG upon a fractionation of the total mixture depending upon the percentage components of the mixture, ensuring that each individual component did not exceed its individual MCLG. This would be calculated as follows:

$$\text{MCLG for Total Aldicarb} = \frac{\text{Aldicarb (measured)}}{0.01 \text{ mg/l}} + \frac{\text{Aldicarb sulfoxide (measured)}}{0.01 \text{ mg/l}} + \frac{\text{Aldicarb sulfone (measured)}}{0.04 \text{ mg/l}} < 1$$

**Public comments:** Six individuals or organizations provided comments on the MCLG proposal for aldicarb. One commenter agreed with EPA that the only acute toxic effect of aldicarb is rapid and reversible inhibition of cholinesterase.

One commenter agreed that an MCLG should be established for aldicarb but felt that a separate MCLG should be proposed for aldicarb sulfone. The reasons cited were that toxicity data on aldicarb and aldicarb sulfoxide are inapplicable to aldicarb sulfone, adequate analytical methods exist to distinguish between the three residues in water and EPA's OPP requires separate food tolerance regulations for aldicarb and aldicarb sulfone.

One commenter stated that aldicarb residues should not be regulated because of the impractical test method. Another commenter stated that analytical methods are not readily available for aldicarb and a health advisory (instead of an MCLG) should be set for aldicarb.

One commenter agreed with EPA in the choice of the NOAEL for aldicarb and aldicarb sulfoxide, but disagreed with the choice of the uncertainty factor. This commenter felt that an uncertainty factor of no less than 10 and no more than 40 for aldicarb and aldicarb sulfoxide was appropriate, based on OPP's historical use of uncertainty factors. For aldicarb sulfone, the commenter felt that an uncertainty factor of 10 was appropriate.

One commenter agreed with EPA's decision to propose an MCLG that is protective of the 70-kg adult, while two commenters stated that by basing the MCLG on the 10-kg child, the 70-kg adult would also be protected.

**EPA response:** EPA agrees that a separate MCLG should be established

for aldicarb sulfone and has proposed an MCLG of 0.04 mg/l for this compound. A discussion of the analytical method for aldicarb and its metabolites is contained in Section IV of this notice.

EPA's Risk Assessment Forum has developed Agency policy on the use of uncertainty factors for data describing cholinesterase inhibition as the most sensitive endpoint of toxicity. OPP and ODW both follow the same policy in the use of an uncertainty factor of 100 with cholinesterase inhibition in the rat studies for aldicarb and its metabolites, and an uncertainty factor of 10 is applied to human data with cholinesterase inhibition. In the case of aldicarb, similar MCLG values were obtained when the uncertainty factors of 10 and 100 were applied, respectively, to the six month rat study and the acute human exposure study (NAS, 1977). EPA believes that applying a lesser uncertainty factor to animal data would not provide an adequate margin of safety in light of the potent nature of the anticholinesterase effect and the steepness of the dose-response curve for this chemical as well as human data discussed by the NAS in 1977.

EPA believes that the uncertainty factor used in the calculation of the DWEL and the 20 percent relative source contribution would account for any difference in sensitivity and thus the MCLG would be adequately protective of the child as well. Public comments are requested on using the 70-kg adult rather than the 10-kg child as the basis for the MCLG.

6. *Atrazine.* EPA did not propose an MCLG for atrazine in the November notice due to limited toxicological data on the chemical. However, since that time further studies have been carried out and EPA believes there are now

sufficient data upon which to base an MCLG for atrazine. EPA is proposing an MCLG of 0.003 mg/l for atrazine, based upon an evaluation of non-carcinogenic effects and a classification of the compound in Group C—possible human carcinogen.

The proposed MCLG is based upon non-carcinogenic effects in a one-year feeding study in dogs (Ciba-Geigy, 1987. Atrazine Technical 52-Week Oral Feeding in Dogs. Study No. 852008 and Pathology Report No. 7048. MRID 40313-01). In this study, five-month old beagle dogs were fed atrazine at the following concentrations: 15, 150, and 1,000 ppm (corresponding to 0.48, 4.97, and 33.65 mg/kg/day). A NOAEL of 0.48 mg/kg/day was identified, based upon the finding of discrete myocardial degeneration at the highest dose level and several findings at the 4.97 mg/kg/day dose level which suggested a trend toward the development of the cardiac pathology seen at the higher dose. An uncertainty factor of 100 was applied (consistent with the guidelines for use with a NOAEL from an animal study), and adjusted for the consumption of 2 liters of water per day for a 70-kg adult, resulting in a DWEL of 0.2 mg/l (rounded from 0.168 mg/l).

A preliminary report submitted by Ciba-Geigy Corporation (previously referenced) in support of atrazine registration indicated that atrazine may be carcinogenic. Preliminary summary incidence information (1-year interim report) on the histopathological findings of their 2-year oncogenicity study of atrazine in Sprague-Dawley rats indicated increased numbers of tumors in the mammary glands of female rats. Also, the completed study reflected a statistically significant dose-related increase in mammary tumors. A paper



by Ciba-Geigy (1987) confirmed the initial findings.

A study by Innes et al. (1969, "Bioassay of Pesticides and Industrial Chemicals for Tumorigenicity in Mice: A Preliminary Note," J. Natl. Cancer Inst. 42:1101-1114) did not show carcinogenic effects for atrazine. In this study, the carcinogenicity of 120 test compounds, including atrazine in mice was investigated. A dose of 21.4 mg/kg was administered by gavage to mice of both sexes from age 7 to 28 days. After weaning at four weeks, this dose level was maintained by administering 82 ppm atrazine in the diet for 18 months. The incidence of hepatomas, pulmonary tumors, lymphomas and total tumors in atrazine-treated mice was not significantly different from the controls. Recently a 90 week mouse oncogenicity study by Ciba-Geigy (1987) was submitted to the Agency. This study is also negative for oncogenicity.

EPA has classified atrazine in Group C (possible human carcinogen) based upon the results of the Ciba-Geigy (1986) study which show evidence of carcinogenicity of atrazine in the female rat. This evidence supports a Group C classification based on EPA's cancer risk guidelines, i.e., limited evidence of carcinogenicity based on studies involving a single species, strain, or experiment (see 52 FR 33992).

An MCLG of 0.003 mg/l (rounded from 0.0034) was determined by applying an additional uncertainty factor of 10 to the DWEL, to account for the classification of atrazine in Group C and factoring in an assumed 20% contribution from drinking water, since adequate occurrence data are not available.

EPA requests comment on the Group C classification for atrazine and the proposed MCLG.

**Public comments:** No public comments were received on atrazine in the November 1985 notice.

**7. Carbofuran.** EPA proposed an MCLG of 0.036 mg/l for carbofuran in the November 1985 Federal Register notice. This was based upon a one-year dietary study in dogs in which a NOAEL of 0.50 mg/kg/day was identified, considering the absence of a biologically significant depression of cholinesterase activity or reproductive effect in the males. Using an uncertainty factor of 100, a DWEL of 0.2 mg/l (rounded from 0.175 mg/l) was calculated. No new relevant data that would change the conclusions presented in the November notice have become available since its publication. EPA is, therefore, repropounding the MCLG at 0.04 mg/l (rounded from 0.035 mg/l).

**Public comments:** Six individuals or organizations commented on the MCLG

proposal for carbofuran. One commenter stated that EPA should consider the metabolites of carbofuran as well as the parent compound itself in developing the MCLG, noting that toxicological exposure is the result of a chemical metabolized in the body. Another commenter disagreed with EPA's statement that carbofuran may result in immune effects, stating that the evidence on this point is questionable.

Four commenters stated that carbofuran should not be regulated because there is little or no occurrence in drinking water. Two commenters felt that a health advisory should be issued instead, until further occurrence information is available. One commenter stated that the MCLG should be calculated for the 10-kg child, since the endpoint of toxicity is an acute phenomena.

**EPA response:** The MCLG for carbofuran is the result of the evaluation of all available toxicological data for carbofuran and its metabolites. Relatively few data are available in which the metabolites were directly tested. However, studies carried out on the parent compound inherently account for the metabolites, since the parent compound is metabolized in the test animal and exhibits toxicity based upon its metabolized form. Thus, an MCLG based on data from the parent compound is adequately protective for the adverse effects due to the metabolites as well.

Studies by Street and Sharma (1975) and Barnett et al. (1980) reported some changes in the immune system that raise questions on the potential for carbofuran to cause adverse effects on this system. EPA believes further research in this area is needed before any conclusions can be made on the effect of this chemical on this toxicological endpoint.

EPA agrees that occurrence of carbofuran is low in drinking water, but believes it is appropriate to set an MCLG based on its adverse health effects and the potential for occurrence in drinking water. In addition, the SDWA Amendments of 1986 mandate that a MCLG and a national primary drinking water standard be set for carbofuran. EPA has based the MCLG on the NOAEL from a one-year dietary study with dogs; the endpoints of toxicity in this study were cholinesterase inhibition and testicular degeneration. With the addition of an uncertainty factor of 100 and a relative source contribution of 20 percent, the MCLG is considered to be adequately protective for the 10-kg child. Further, the proposed MCLG (40 ug/l) is more protective to the child than the

computed child value based on the acute human exposure study (50 ug/l).

**8. Chlordane.** EPA proposed an MCLG of zero for chlordane based on sufficient evidence of carcinogenicity in animals (Group B2) in the November 1985 proposal. No new data which change the conclusions presented in that notice have become available since its publication. EPA is, therefore, repropounding an MCLG of zero for chlordane.

EPA has received new data regarding the toxicity of chlordane. While the proposed MCLG of zero is based on the carcinogenicity of this contaminant, the new toxicity data are presented to provide information on the full range of adverse effects of chlordane. EPA calculated a DWEL of 0.03 mg/l for chlordane in the November proposal, based upon a two-year feeding study in dogs. The results of a chronic rat dietary study (Yonemura et al., 1983; Thirty-month Chronic Toxicity and Tumorigenicity Test in Rats by Chlordane; submitted to OPP) were used to calculate a revised DWEL. This study was conducted in 1983 but was not submitted to the Agency until 1985. In this study, F344 rats were fed technical chlordane at dietary levels of 0, 1, 5 or 25 ppm for 130 weeks. Regional hypertrophy was observed in female rats at a dosage of 0.273 mg/kg/day. A NOAEL of 0.055 mg/kg/day was identified based on liver hypertrophy. Applying an uncertainty factor of 1,000, (100 for the inter and intraspecies difference and ten for the lack of a second chronic toxicity study-reproductive study), a revised DWEL of 0.002 mg/l has been derived, assuming consumption of 2 liters of water per day by a 70-kg adult. Since chlordane has sufficient evidence of carcinogenicity, this DWEL has not been used to set the MCLG.

**Public Comments:** No public comments were received on the proposed MCLG for chlordane.

**9. Dibromochloropropane (DBCP).** EPA proposed an MCLG of zero for DBCP based on sufficient evidence of carcinogenicity in animals (Group B2) in the November 1985 Federal Register notice. No new data which change the conclusions presented in that notice have become available since its publication. EPA is, therefore, repropounding an MCLG of zero for DBCP.

**Public Comments:** Five individuals or organizations commented on the MCLG proposal for DBCP. Two commenters submitted an alternate risk assessment for DBCP. A maximum likelihood risk of cancer of  $4.6 \times 10^{-6}$  for lifetime exposure to drinking water containing 0.1 mg/l



was calculated from the geometric mean of five risk estimates using different risk assessment models. Although the commenters and EPA used the same chronic study to develop risk estimates, different mathematical modeling was used in the risk assessments. The commenters urged EPA to set the MCLG at 0.1 mg/l based on their risk assessment. In addition, they stated that additional analysis of metabolites is needed and that the available epidemiologic data do not support an association between DBCP exposure and tumor formation in humans.

One commenter asserted that the occurrence information provided in the Federal Register notice was not adequate, since dates and locations of sampling were not described nor were detection limits or measured values given.

One commenter agreed with the proposal. Another commenter stated that there appears to be sufficient preliminary data available to warrant consideration of DBCP for regulation, but that additional research is needed before promulgation of an MCLG/MCL for this compound.

**EPA response:** EPA cannot adopt the commenter's revised risk assessment. There is no biostatistical basis for this risk assessment procedure, and the probit model used as one of the 5 models skews the risk estimate to an unreasonably low value. Also, EPA believes the 95% upper bound to be a more appropriate normalizing method than maximum likelihood estimates. However, EPA acknowledges that, as noted by the commenter, additional analysis of metabolites would strengthen the unit risk value. However, EPA does not believe that this analysis is essential to setting a risk number of DBCP. By EPA's risk assessment procedure, an exposure of 0.1 mg/l will result in an upper bound risk value of  $4 \times 10^{-3}$ . Furthermore, as EPA has explained in the November 1985 notice and elsewhere in this notice, the Agency has decided to establish a zero MCLG for contaminants, such as carcinogens, for which no threshold for adverse effects has been identified (*NRDC v. Thomas*, 824 F.2d 1211 (D.C. Cir. 1987)).

Regarding the epidemiology data on DBCP, EPA believes that the epidemiology data base is inadequate to refute or demonstrate that DBCP causes tumors in humans. EPA believes there are sufficient data to conclude that DBCP is carcinogenic in animals since the compound has been shown to be carcinogenic in both rats and mice. EPA therefore has classified DBCP in Group B2: probable human carcinogen.

Regarding the occurrence data presented by EPA, the Federal Register notice was intended to present only a summary of the data. A detailed presentation of the data may be found in the occurrence support document, which is available in the public docket.

EPA disagrees that the health data are currently inadequate to establish an MCLG. DBCP has been shown to exhibit acute and chronic toxic effects in animal studies, reproductive effects in humans and has also been shown to be carcinogenic in animal studies.

10. *o*-Dichlorobenzene. In the November 1985 proposal, EPA proposed an MCLG of 0.62 mg/l for *o*-dichlorobenzene based on the occurrence of liver and kidney lesions and porphyria in rats. EPA discussed the relevant toxicologic data in detail in that notice. EPA also discussed the lack of adequate toxicological data for *m*-dichlorobenzene, and declined at that time to propose an MCLG for the meta isomer. Instead, EPA sought data and comments on the appropriateness of setting a standard for *m*-dichlorobenzene based on the toxicity data from *o*-dichlorobenzene. No new relevant data which change the conclusions presented in that notice have become available since its publication. EPA is therefore repropounding the MCLG of 0.6 mg/l for *o*-dichlorobenzene (rounded from the proposed value of 0.62 mg/l), and is not proposing an MCLG for *m*-dichlorobenzene.

**Public comments:** Four individuals or organizations submitted comments on EPA's proposed actions on *o*- and *m*-dichlorobenzene. One commenter agreed with the proposal. One commenter believed that no MCLG should be developed for *o*-dichlorobenzene because it is infrequently detected in drinking water, and when it is detected, the levels are well below the DWEL. Another commenter stated that it is appropriate to base an MCLG for *m*-dichlorobenzene on the data on the ortho isomer, but as an interim step only. Another commenter disagreed with basing an MCLG for *m*-dichlorobenzene on the data on the ortho isomer, because the meta isomer is rarely found in drinking water and because there are few data relating the meta and ortho isomers to one another.

**EPA response:** EPA agrees that *o*-dichlorobenzene is infrequently detected in drinking water supplies and meta even less so. However, EPA is required to establish a standard for this compound under the provisions of the 1986 amendments to the Safe Drinking

Water Act. In addition, *o*-dichlorobenzene has been detected in wastewater and hazardous waste and thus the potential exists for drinking water contamination. The infrequent occurrence has been taken into account in the proposed monitoring requirements (see Section VI). EPA is not proposing an MCLG for *m*-dichlorobenzene at the present time because of the lack of data, but may develop a standard in the future as data become available.

11 and 12. *cis*-1,2-Dichloroethylene and *trans*-1,2-Dichloroethylene. EPA proposed an MCLG of 0.07 mg/l for both *cis*- and *trans*-1,2-dichloroethylene in the November 1985 proposal based upon a two-year study on 1,1-dichloroethylene in which a DWEL of 0.4 mg/l (rounded from 0.35 mg/l) was determined. At that time, compound-specific data were not available for either *cis*- or *trans*-1,2-dichloroethylene, and thus data on 1,1-dichloroethylene were used to set the MCLGs for both compounds. Since the time of the proposal, compound-specific data on *trans*-1,2-dichloroethylene have become available, and this data has been used to determine the DWEL and MCLG for *trans*-1,2-dichloroethylene. No new data are available on *cis*-1,2-dichloroethylene, and thus the MCLG is repropounded at 0.07 mg/l.

The MCLG for *trans*-1,2-dichloroethylene is based on a study by Barnes et al. (Barnes et al. 1985. Toxicology of *trans*-1,2-Dichloroethylene in the Mouse. *Drug Chem. Toxicol.* 8:373-392) in which CD-1 mice (15-24/sex/dose) were given *trans*-1,2-dichloroethylene for 90 days in their drinking water at levels of 17, 175 or 387 mg/kg/day for males and 23, 224 or 452 mg/kg/day for females. There were no changes in fluid consumption, body weight gain or gross pathology among the experimental groups. In male mice, significant increases in serum alkaline phosphatase were noted at the two highest dose levels. In females, the thymus weight, calculated as percent body weight, was significantly depressed at the 224 and 452 mg/kg/day doses, while the lung weight was decreased only at the highest dose. A NOAEL of 17 mg/kg/day in male mice was identified based on normal serum chemistry values in male mice. A DWEL of 0.6 mg/l was derived using 17 mg/kg/day as the NOAEL and an uncertainty factor of 1,000, based upon the use of a NOAEL from an animal study which is of less-than-lifetime duration. Factoring in a 20 percent relative source contribution for drinking water results in an MCLG of 0.1 mg/l for *trans*-1,2-dichloroethylene.



EPA requests comment on whether the MCLG for cis-1,2-dichloroethylene should be based upon the same data used to set the MCLG for trans-1,2-dichloroethylene. This would result in an MCLG of 0.1 mg/l for cis-1,2-dichloroethylene, instead of the value of 0.07 mg/l which is being proposed.

**Public comments:** Five individuals or organizations commented on the MCLG proposal for cis- and trans-1,2-dichloroethylene. One commenter agreed with the proposal. One commenter stated that an MCLG should not be established for these compounds because there are no data to show that exposure occurs or will occur above safe levels.

One commenter stated that it may be sufficient on an interim basis to employ data on the toxicity of 1,1-dichloroethylene to derive an MCLG for cis- and trans-1,2-dichloroethylene, but that a concerted effort should be made to develop data for these isomers that will be more reliable for derivation of MCLG values.

One commenter stated that it is not reasonable to compare the health effects of two compounds with similar chemical structure in the absence of chemical-specific toxicity data. Another commenter felt that before establishing an MCLG of 0.07 mg/l for 1,2-dichloroethylenes, EPA should assure that biodegradation will not produce vinyl chloride at concentrations greater than 0.001 mg/l.

**EPA Response:** The Ground Water Supply Survey detected 1,2-dichloroethylenes in 3.4 percent of the random samples. Thus, EPA believes that there is sufficient occurrence to warrant regulation for the 1,2-dichloroethylenes. (See Section VI). In addition, the SDWA Amendments of 1986 require that a drinking water regulation be set for cis- and trans-1,2-dichloroethylene.

EPA agrees that chemical-specific data, when available, should be used to develop the MCLGs. Since EPA has recently received data on the toxicity of trans-1,2-dichloroethylene following exposure by the oral route, these data have been used to set the MCLG for trans-1,2-dichloroethylene.

EPA believes that basing the MCLG for a compound on the health effects of compounds with similar chemical structure is appropriate when there is insufficient data on the compound of concern and when available data indicate that the compounds exhibit similar toxicity characteristics. There are data from shorter term exposures on all three dichloroethylene isomers suggesting that they have similar toxicity in the qualitative sense, i.e.,

they affect the same general organ systems. In light of this data reflecting similar structure activity relationships, EPA believes it is reasonable to use data on 1,1-dichloroethylene until such time as isomer-specific data becomes available on cis-1,2-dichloroethylene.

EPA does not believe that the MCLG for the 1,2-dichloroethylenes should be based on their conversion to vinyl chloride. A drinking water MCL has been set for vinyl chloride at 0.002 mg/l (see 52 FR 25690); the vinyl chloride MCL will adequately protect the public against any vinyl chloride which may be produced through the biodegradation of the 1,2-dichloroethylenes. As outlined in the vinyl chloride rule, water supplies must test for vinyl chloride whenever the 1,2-dichloroethylenes are found. The 1,2-dichloroethylenes have been shown to exhibit toxic effects in their own right and thus, the MCLG for this compound must adequately protect against these effects.

**13. 1,2-Dichloropropane.** EPA proposed an MCLG of 0.006 mg/l for 1,2-dichloropropane in the November 1985 proposal. In that proposal, 1,2-dichloropropane was classified in EPA's Group C, and the MCLG was set at a non-zero level based on the  $10^{-5}$  carcinogenic risk level. Discussion of the available human exposure data and health effects of 1,2-dichloropropane were presented in the November 1985 proposal. Based on data which has become available since the 1985 proposal, EPA is revising the carcinogenic classification of this contaminant to Group B2, probable human carcinogen, and is therefore repropounding an MCLG of zero for 1,2-dichloropropane. In this notice, the discussion is confined to the conclusion and justification for EPA's revision of the carcinogenic classification for the compound.

The final NTP technical report (1986) on the toxicology and carcinogenesis studies of 1,2-dichloropropane in F344/N rats and B6C3F<sub>1</sub> mice is available for the carcinogenicity evaluation of 1,2-dichloropropane. The report was not available at the time of the November 1985 notice. The results of the bioassay showed a statistically significant increased incidence of hepatocellular neoplasms, primarily adenomas in male and female B6C3F<sub>1</sub> mice. The frequency of liver carcinomas alone was not significant for males or females but there was an increase in tumors in both sexes (male: Control, 11/50; low dose, 16/50; high dose, 16/50; female: Control, 1/50; low dose, 3/50; high dose, 4/50). There was no statistically significant increase in tumors of any specific organ in F344 rats; however, there was a dose-

related trend (by life table analysis) on mammary adenocarcinomas in the female rats. The increased adenocarcinoma incidence in the female rat is considered to be significant since the F344 rat has a relatively low background occurrence rate for these tumors. Also, high mortality during the course of the bioassay may have precluded higher incidence observations (i.e., some animals that died may have developed tumors had they survived for the duration of the study).

EPA believes that the results of the bioassay lend support for a Group B2 classification for 1,2-dichloropropane by virtue of the positive response in mice together with the dose related trend in mammary adenocarcinomas in the female rat. Other considerations are that 1,2-dichloropropane: (1) Has shown positive mutagenic activity in short-term tests, and (2) is metabolized to 1,2-epoxypropane and chloroacetaldehyde. 1,2-Epoxypropane is thought to have carcinogenic potential since other epoxy compounds are known carcinogens. In addition, 1,2-dichloropropane has a structural relation to compounds with known carcinogenic activity in animal test systems (1,2-dichloroethane, 1,2-dibromoethane, and 1,2-dibromo-3-chloropropane). EPA believes that considering the total weight of evidence, 1,2-dichloropropane should be classified in Group B2.

Comment is requested on this proposed classification. If after consideration of public comments and further evaluation of the data EPA decided to classify 1,2-dichloropropane in Group C, the MCLG would be 0.006 mg/l, as proposed in the November 1985 notice.

**Public comments:** Seven individuals or organizations commented on the proposed MCLG for 1,2-dichloropropane. Several commenters opposed development of an MCLG for 1,2-dichloropropane. The major objection was that the occurrence of 1,2-dichloropropane in the environment is very low and decreasing, and the environmental levels do not result in exposure to a significant portion of the population.

Three commenters opposed the MCLG because they believed the toxicology studies to be weak. The commenters also challenged the classification of this contaminant in Group C on the grounds that the NTP bioassay had not been validated, that the mouse tumor data alone was inadequate to support this classification, that the relevance of mouse liver tumors to carcinogenic risk in humans is unclear, and the cancer frequency in the concurrent controls



was higher than in historical controls. One commenter agreed that there are inadequate data to establish a DWEL.

**EPA response:** While EPA agrees that the environmental occurrence of 1,2-dichloropropane is likely to be limited, it has been found in wells in California and New York, in one hazardous waste site and in the ambient air in several cities. EPA believes the occurrence is sufficient to warrant an MCLG for the compound. In addition, the 1986 Amendments to the SDWA require that an MCLG be set for 1,2-dichloropropane.

EPA believes that the data are adequate to form the basis for an MCLG and to support a carcinogenicity classification of Group B2. The final report from the NTP bioassay has been peer reviewed and audited by NTP, and under the conditions of the study, 1,2-dichloropropane was considered to be carcinogenic to male and female mice, although the effect in rats was equivocal. EPA considers mouse liver tumors to be sufficient evidence of carcinogenicity (see the EPA Guidelines for Carcinogenic Risk Assessment (51 FR 33992)) and thus EPA disagrees with the commenter regarding the relevance of mouse liver tumors. Regarding the cancer frequency in the controls, the NTP study has been peer reviewed and audited and found to be adequate. The cancer frequency in the controls does not invalidate the results.

14. **2,4-D.** EPA proposed an MCLG of 0.07 mg/l for 2,4-D in the November 1985 proposal, based on adverse effects on the liver and kidney in test animals. EPA based this MCLG on a NOAEL of 1 mg/kg/day, a safety factor of 100, and the assumption that a 70 kg adult consumes 2 liters of water per day. EPA also assumed that 20% of total exposure to 2,4-D would be from drinking water. No new relevant data which change EPA's conclusions have become available since publication of that notice. EPA is, therefore, reproposing an MCLG of 0.07 mg/l for 2,4-D.

EPA is also considering adopting an MCLG of 0.02 mg/l for 2,4-D. This is based upon the same study as used to calculate the proposed MCLG, with the application of an additional uncertainty factor of 3 to the calculations. This uncertainty factor would be applied to account for the fact that supporting long-term data in dogs are not available for 2,4-D.

**Public Comments:** Five individuals or organizations submitted comments on EPA's proposed MCLG for 2,4-D. One commenter requested that EPA include more details on the analytical methods for 2,4-D in the Federal Register. One commenter disagreed with EPA's human exposure assessment, citing very low

occurrences in air and food, and low occurrence in drinking water. This commenter stated that most levels of 2,4-D in drinking water are at or below the detection limit and thus it was not appropriate to use a 20 percent drinking water contribution for 2,4-D.

Two commenters stated that an MCLG should not be established for 2,4-D because the health effects data are too weak, and one commenter stated that establishing an MCLG should be postponed until ongoing toxicity studies are completed. These commenters stated that studies other than those used by EPA should be relied upon in developing the MCLG, and that the estimated relative source contribution of 20% estimated by EPA in the November 1985 notice was inappropriate because air and food are not significant exposure sources.

**EPA response:** EPA has included a more detailed discussion of the analytical methods for 2,4-D in Section IV of this notice. Regarding drinking water exposure to 2,4-D, EPA agrees that 2,4-D has only been detected at very low levels in drinking water supplies. In the absence of reliable data to the contrary, EPA conservatively estimates that drinking water might contribute 20% to total exposure. EPA has examined the occurrence data presented by the commenter, but believes they are insufficient to estimate the relative source contribution and thus believes it is appropriate to use a 20% estimate for exposure.

EPA believes that the available toxicity data on 2,4-D are adequate to form the basis of a regulation for the reasons outlined in the November 1985 notice. Four human studies cited by the commenter as a more appropriate basis for the MCLG are not valid for this purpose. Two were designed as metabolism and fate studies and did not (i.e., by design) provide adequate toxicity information. Another study used only one subject, and the fourth study was not useful because exposure levels were not known.

15. **Epichlorohydrin.** EPA proposed an MCLG of zero for epichlorohydrin based on its carcinogenic potential in humans in the November 1985 notice. EPA has classified epichlorohydrin in Group B2: probable human carcinogen, based on positive results in several carcinogenicity bioassays with rats exposed to epichlorohydrin via multiple routes of administration. Exposure by ingestion, either via gavage or drinking water, resulted in tumors of the forestomach and exposures via inhalation resulted in tumors of the nasal cavities. No new relevant data which change EPA's conclusions have

become available since publication of that notice. EPA is therefore reproposing an MCLG of zero for epichlorohydrin.

**Public comment:** Eight individuals or organizations commented on EPA's proposed MCLG for epichlorohydrin. One commenter provided additional information on health effects and metabolism of epichlorohydrin, including data indicating that oxalic acid is not a likely metabolite of epichlorohydrin, that epichlorohydrin is rapidly absorbed, metabolized and excreted when given orally, and that the available data on central nervous system effects are from Soviet studies which lack detail. This commenter asserted that while epichlorohydrin poses risks to humans, it is not possible to quantitate the risks at this time.

Several other commenters disagreed with EPA's decision to establish an MCLG for epichlorohydrin, stating that exposure through drinking water is low, even though epichlorohydrin-based resins are used in drinking water treatment. Additional reasons cited by the commenters were that analysis for epichlorohydrin is difficult and that the regulation would have an adverse economic impact.

One other commenter disagreed that there is an adequate basis for the DWEL, and disagreed with the basis for the carcinogenicity risk calculations, urging EPA to rely on the study by (Wester et al. [Wester, P.W., van der Heiden, C.A., Bisschop, A., and van Esch, G.J. 1985. "Carcinogenicity Study with Epichlorohydrin (CEP) by Gavage in Rats." *Toxicol.* 36:325-329) as the basis for the carcinogenic risk calculations rather than that by Konishi et al. (Konishi, T., Kawabata, A., Denda, A., et al. 1980. "Forestomach Tumors Induced by Orally Administered Epichlorohydrin in Male Wistar Rats." *Gann.* 71:922-933), and suggested that EPA use a risk level of  $10^{-4}$  as the basis for the MCLG.

**EPA response:** EPA disagrees with the commenter that oxalic acid is not a likely metabolite of epichlorohydrin. EPA has relied on a study by the same laboratory as that cited by the commenter, indicating that oxalic acid is responsible for the renal toxicity of epichlorohydrin. The data submitted on absorption and metabolism of epichlorohydrin will be incorporated into the Health Criteria Document. EPA agrees that the Soviet literature was incomplete, and the studies are included in the Criteria Document for informational purposes only (i.e., the studies are not used as the basis for the DWEL or the MCLG). EPA believes the current data are adequate to calculate



cancer risks for epichlorohydrin since the data consist of high quality dose-response information in animals.

EPA believes it is appropriate to establish an MCLG for epichlorohydrin at this time. EPA's occurrence estimates are based largely on residue from its use as a drinking water flocculant. While typical levels of epichlorohydrin in drinking water should be quite low because of likely chemical reactions in water of trace residues, its common usage and thus the clear potential for contamination justifies the promulgation of NPDWRs for this contaminant. Furthermore, the SDWA requires EPA to regulate epichlorohydrin. The availability of analytical methods and cost considerations are evaluated by the Agency in promulgating the enforceable MCL or treatment technique and monitoring requirements. These factors are not relevant to the establishment of the MCLG.

Regarding calculation of the DWEL, EPA believes the published literature, which contains several long-term studies, provides an adequate data base for establishing the DWEL for epichlorohydrin. EPA agrees that the study by Wester et al. (1985) is a valid study but EPA continues to use the study by Konishi et al. (1980) as the basis for the quantitative risk estimate for oral exposure. Forestomach tumors in rats were seen in both studies, but the drinking water exposure route used by Konishi et al. is considered more relevant than the gavage exposure route used by Wester et al. As EPA has explained in the November 1985 notice and in other rulemakings, the Agency has decided to establish a zero MCLG for contaminants which have shown sufficient evidence of carcinogenicity. Since epichlorohydrin has been classified in Group B2, EPA has repropounded an MCLG at zero for the compound.

16. *Ethylbenzene*. EPA proposed an MCLG of 0.68 mg/l for ethylbenzene in the November 1985 notice based on adverse effects on the kidney and liver in test animals. EPA based the MCLG on a NOEL of 136 mg/kg/day, an uncertainty factor of 1000, a factor of 5/7 to convert from 5 day per week exposure (by gavage) to daily exposure, and an estimated water consumption of 2 liters per day for a 70-kg adult. From these assumptions, EPA calculated a DWEL of 3 mg/l (rounded from 3.4 mg/l); because adequate exposure data were not available, EPA estimated that the drinking water contribution was 20 percent, resulting in an MCLG of 0.68 mg/l. No new relevant data that would change EPA's conclusions have become

available since the publication of the November 1985 notice. EPA is, therefore, repropounding an MCLG of 0.7 mg/l for ethylbenzene, rounded from the proposed MCLG of 0.68 mg/l.

*Public comment*: Five individuals or organizations commented on the proposed MCLG for ethylbenzene. One commenter agreed with the proposal. Two commenters felt that an MCLG should not be established because ethylbenzene is infrequently detected in water; when present, is at levels below the DWEL; and there are no studies showing that ethylbenzene in drinking water has caused human health problems. The other commenter felt that the assumed 20 percent estimated contribution from drinking water is arbitrary and overly conservative.

*EPA response*: EPA agrees that ethylbenzene is unlikely to occur in drinking water at levels approaching the DWEL. However, EPA is required by the 1986 Amendments to the SDWA to develop an MCL for ethylbenzene. EPA estimates a 20 percent contribution from drinking water when adequate, reliable data on human exposure are not available to make another estimate. This conservative approach takes into account the possibility of exposure to contaminants through other sources, even though that exposure cannot be quantified. Since adequate data are not available to determine the proportion of exposure to ethylbenzene through drinking water, EPA assumes a 20 percent relative source contribution.

17. *Ethylene Dibromide (EDB)*. EPA proposed an MCLG of zero for EDB based on sufficient evidence of carcinogenicity in animals (Group B2) in the November 1985 Federal Register notice. EPA presented a detailed discussion of the adverse health effects and occurrence of EDB in that notice. No new relevant data which change the conclusions presented in that notice have become available since its publication. Therefore, EPA is repropounding an MCLG of zero for ethylene dibromide.

*Public comment*: Three individuals or organizations commented on the MCLG proposal for EDB. One commenter disagreed with the MCLG, stating that it should be set at a non-zero level based on quantitative risk assessments derived from mathematical models or based on a LOAEL with an appropriate uncertainty factor. One commenter stated that the Agency is using flawed test data which is not sufficient for extrapolating risk to humans.

*EPA response*: EPA believes that the available data are adequate to classify EDB in Group B2, probable human

carcinogen and therefore an MCLG of zero is appropriate for the reasons explained in Section IIIB of this notice.

18. and 19. *Heptachlor and Heptachlor Epoxide*. In the November 1985 proposal, EPA proposed MCLGs of zero for both heptachlor and heptachlor epoxide based on sufficient evidence of carcinogenicity (Group B2) in animals. No new data which change the conclusions presented in that notice have become available since its publication. EPA is, therefore, repropounding an MCLG of zero for heptachlor and an MCLG of zero for heptachlor epoxide.

EPA has revised the DWELs for heptachlor and heptachlor epoxide. These revisions do not affect EPA's conclusions about heptachlor and heptachlor epoxide carcinogenicity, but are presented to provide more information on the health effects of these compounds. In the November 1985 proposal, EPA calculated a DWEL based on noncarcinogenic endpoints of 0.0025 mg/l for heptachlor, based upon a 110-day feeding study in rats (Witherup et al., 1955) and a LOAEL of 0.075 mg/kg/day. However, a reanalysis of the data indicate that a NOAEL of 0.15 mg/kg/day is more appropriate, based upon a consideration of different endpoints. Using this NOAEL and an uncertainty factor of 300, a revised DWEL of 0.02 mg/l (rounded from 0.0175 mg/l) has been calculated. An uncertainty factor of 100 was used to account for inter- and intra-species differences. An additional uncertainty factor of 3 was used to account for the fact that the most sensitive toxicological endpoint may not have been determined in the study, i.e., very few endpoints were examined in this 1955 study.

For heptachlor epoxide, a DWEL of 0.001 mg/l was calculated in the November 1985 proposal, based upon a two-generation reproduction study in dogs. A reanalysis of the data has indicated that a 60-week feeding study in dogs (Unpublished, 1958, Kettering Laboratory 60-week dog feeding study) is more appropriate for the derivation of a DWEL, since a larger number of endpoints were examined in this study. In this study, animals were given 0, 0.5, 2.5, 5 or 7.5 ppm heptachlor epoxide in the diet. Effects were noted for both males and females at the 0.5 ppm (0.0125 mg/kg/day) dose level of heptachlor epoxide. Using 0.0125 mg/kg/day as the LOAEL and an uncertainty factor of 1,000, a revised DWEL of 0.0004 mg/l has been derived. Since heptachlor and heptachlor epoxide have sufficient evidence of carcinogenicity, the revised



DWELs have not been used to set the proposed MCLGs.

**Public comments:** Four individuals or organizations commented on the MCLG proposal for heptachlor and heptachlor epoxide. One commenter recommended reclassifying heptachlor and heptachlor epoxide to EPA Group C (possible human carcinogen) because rodents have an extremely high background of liver cancer and are not appropriate surrogates for extrapolation to humans. Three commenters stated that a single MCLG for heptachlor and heptachlor epoxide is adequate, since carcinogenic potential has been shown for both.

**EPA response:** According to EPA's guidelines for classification of carcinogens, Group B2 is used when there is sufficient evidence of carcinogenicity in animals and inadequate data in humans. These guidelines also state that mouse liver tumor data should be taken as sufficient evidence of carcinogenicity, unless specific information on the compound's toxicology would warrant a different classification. The analysis of the data for heptachlor and heptachlor epoxide show sufficient evidence of carcinogenicity in the mouse, as well as some evidence in the rat, a second species. This analysis considered the results of the NCI 1976 bioassay, based on the evaluation of slides by independent pathologists. Thus, EPA believes a Group B2 classification is justified.

The relative toxic and carcinogenic effects of heptachlor and heptachlor epoxide vary with respect to dose levels in animals. In addition, both of these compounds have been detected in drinking water. Thus, EPA believes it is appropriate to develop separate MCLGs for these chemicals.

**20. Lindane:** EPA proposed an MCLG of 0.0002 mg/l for lindane in the November 1985 proposal, based upon a DWEL of 0.01 mg/l, an additional uncertainty factor of 10 (since lindane was classified as Group C—possible human carcinogen) and 20% contribution from drinking water. No new data which change the conclusions presented in that notice have become available since its publication. EPA is, therefore, repropounding an MCLG of 0.0002 mg/l for lindane.

**Public comments:** Six individuals or organizations commented on the MCLG proposal for lindane. Several commenters disagreed with the establishment of an MCLG for lindane, citing weak health effects data and low occurrence. One commenter suggested that rulemaking could be delayed since there is an MCL already in effect. One commenter stated that the MCLG should

be zero for lindane since it has been demonstrated to cause malignant liver tumors in two strains of mice.

One commenter supported the classification of lindane in Group C and discussed the use of alternate studies cited in the *Federal Register* to derive the DWEL.

**EPA response:** EPA believes there are sufficient health effects data to support the proposed MCLG for lindane. Acute exposure to lindane results in neurological and behavioral effects. Subchronic and chronic studies have shown a variety of effects, including liver hypertrophy, kidney tubular degeneration and interstitial nephritis. EPA recognizes that occurrence of lindane in public water supplies is likely to be limited and has taken this into account in the proposed monitoring requirements (See section VI). In addition, the SDWA Amendments of 1986 require that a drinking water regulation be set for lindane. The existence of a current MCL for lindane does not justify delaying this rulemaking. The 1986 Amendments require EPA to promulgate an MCL for lindane notwithstanding the current MCL.

Regarding the carcinogenic potential of lindane, the only evidence of carcinogenicity is in mice. An effect has been reported in only one species, and according to the EPA Guidelines for Carcinogen Risk Assessment, this results in a Group C classification. Therefore, a non-zero MCLG has been proposed for lindane.

**21. Methoxychlor.** EPA proposed an MCLG of 0.34 mg/l for methoxychlor in the November 1985 notice. The adverse health effects and occurrence of methoxychlor are discussed in detail in that notice. The MCLG was based on a rat study in which a NOAEL of 5 mg/kg/day was identified and an uncertainty factor of 100 was applied, resulting in a DWEL of 2 mg/l (rounded from 1.75 mg/l). EPA also assumed that drinking water contributes 20% to the overall exposure of methoxychlor. EPA is repropounding an MCLG of 0.4 mg/l for methoxychlor (the number was rounded to 0.4 mg/l based upon a DWEL of 1.75, instead of 1.7, which was used in the November 1985 notice). However, it should be noted that the Office of Pesticides Program (OPP) recently received a teratology study in rabbits (Kincaid Enterprises, Inc. 1986. MRID 00159929). EPA is currently reviewing this study. The MCLG for methoxychlor may be changed if EPA determines that the study is appropriate for determining the MCLG for this contaminant. The study is included in the record for this proposal and EPA requests comment on

whether it should be relied upon in determining the MCLG.

**Public comments:** Three individuals or organizations submitted comments on the proposed MCLG for methoxychlor. One commenter agreed with the proposal. Two commenters disagreed with proposing an MCLG for methoxychlor because of the lack of occurrence and exposure data.

**EPA response:** EPA agrees that the available data indicate that the occurrence of methoxychlor in drinking water supplies is not widespread. However, EPA is required by the 1986 Amendments to the SDWA to set an MCL for methoxychlor. The available occurrence data has been taken into account in the proposed monitoring requirements for methoxychlor (see section VI).

**22. Monochlorobenzene.** EPA proposed an MCLG of 0.06 mg/l for monochlorobenzene in the November 1985 proposal. Discussions of the available human exposure data and health effects of monochlorobenzene were presented in the November 1985 proposal. This notice will discuss only the new data and conclusions that have been changed since publication of that notice, resulting in a repropounded MCLG of 0.1 mg/l.

In the November 1985 proposal, EPA calculated a DWEL for monochlorobenzene based upon a subchronic study in which rats and mice were administered monochlorobenzene five times weekly by gavage in corn oil. (Battelle-Columbus. 1978.

"Chlorobenzene. Subchronic Toxicity Study in B6C3F1 Mice." Unpublished report; and Battelle-Columbus. 1978. "Chlorobenzene. Subchronic Toxicity Study—Fischer 344 Rats." Unpublished report.) A NOAEL of 125 mg/kg/day, a conversion factor of 5/7 to average exposure over a week, and an uncertainty factor of 1,000 were used, resulting in a DWEL of 3.0 mg/l (rounded from 3.125 mg/l). An additional uncertainty factor of 10 was then applied, since monochlorobenzene was classified in Group C by the EPA carcinogenicity guidelines. This resulted in an MCLG of 0.06 mg/l, assuming 20 percent contribution from drinking water.

EPA presently believes a subchronic study in dogs given monochlorobenzene five times weekly orally by capsule is the best study available to calculate the MCLG. (Hazelton Laboratories. 1967. "13-Week Oral Administration—Dogs. Monochlorobenzene." Final report, submitted to Monsanto Company. Project No. 241-105; and Knapp, W.K., Busey, W.M., and Kundzins, W. 1971.



"Subacute Oral Toxicity of Monochlorobenzene in Dogs and Rats." *Toxicol. Appl. Pharmacol.* 19:393 (Abstract). This study was considered in 1985 for derivation of the DWEL but was not used due to the availability of a newer study. However, discussions with the investigating pathologist concerning the interpretation of liver pathology in the dog study in which he stated that 55.5 mg/kg/day should be considered the LOAEL and 27.25 mg/kg/day should be considered the NOAEL have resulted in support for a lower NOAEL for the compound. Thus, EPA now believes it is prudent to base the MCLG on the Hazelton dog study. Using this study, EPA has selected a NOAEL of 27.25 mg/kg/day, since liver lesions attributable to treatment with monochlorobenzene were observed in dogs at doses above 27 mg/kg/day. Adjusting the NOAEL by 5/7 (because the dose was only administered for 5 days per week), and applying an uncertainty factor of 1,000, a DWEL of 0.7 mg/l (rounded from 0.694 mg/l) has been calculated. An uncertainty factor of 1,000 was applied since the study was of a duration significantly less-than-lifetime.

EPA also believes that monochlorobenzene should be classified in Group D, rather than Group C as originally proposed. In the original proposal, the classification of Group C was based upon the results of the NTP bioassay in which monochlorobenzene increased the occurrence of neoplastic nodules of the liver in the high dose male rats. Carcinogenic effects were not observed in female rats or mice of either sex. Other evidence relevant to the carcinogenicity weight of evidence included the results of mutagenicity assays, with positive results in yeast and fungi and negative results in bacteria and cultured mouse lymphoma cells.

EPA has reexamined these data and believes they are insufficient to support a Group C classification. In the NTP bioassay, the incidence in neoplastic nodules of the liver in high-dose male rats was increased compared to controls. EPA no longer believes this increase to have statistical significance. The NTP only considered the incidence of neoplastic nodules in the analysis of the results and did not include in its results the presence of hepatocellular carcinomas in two vehicle male rats. EPA's policy is to combine both malignant and benign tumors when analyzing data (see EPA's Guidelines for Carcinogen Risk Assessment, 51 FR 33992). Thus, when EPA combined the data on hepatocellular carcinoma with the data for neoplastic nodules, the

response in high-dose males was reduced to borderline significance by only one statistical test. There was no increase in incidence of hepatocellular carcinomas in male rats or of neoplastic nodules or hepatocellular carcinomas in female rats. These data are, therefore, judged to be inadequate for a Group C assessment of carcinogenicity.

EPA also believes that the mutagenicity data and other data relevant to the weight of evidence provide inadequate support for a Group C classification. The formation of carcinogenic metabolites, either reactive intermediates (epoxides) such as 3,4-chlorobenzene oxide or benzene, had been proposed as a possible mechanism leading to monochlorobenzene carcinogenicity. On further review and with input from EPA's Science Advisory Board, EPA has concluded that this is not the case. EPA's Science Advisory Board stated that the mechanism of monochlorobenzene toxicity is not known. Neither monochlorobenzene nor its metabolites induce DNA damage or mutations in standard mutagenicity assays. Epoxide intermediates either are readily conjugated via a glutathione transferase pathway or spontaneously rearrange to form chlorophenols which then undergo conjugation. Benzene is not formed as a metabolite; metabolism via other pathways also terminates with the excretion of conjugated chlorophenols.

Hence, EPA believes, with concurrence from EPA's Science Advisory Board, that a Group D classification is more appropriate for monochlorobenzene.

In summary, EPA has recalculated a DWEL of 0.7 mg/l (rounded from 0.675 mg/l), based upon a different study than was used in the MCLG proposal. Assuming a 20 percent contribution from drinking water results in an MCLG of 0.1 mg/l (rounded from 0.139 mg/l). EPA has reclassified monochlorobenzene in Group D, so an additional uncertainty factor of 10 was not applied.

**Public comments:** Eight individuals or organizations commented on the proposed MCLG for monochlorobenzene. One commenter felt that the statement in the *Federal Register* that monochlorobenzene has been shown to cause mutagenic effects in higher plants and certain microorganisms was a misrepresentation of the actual data, since mutagenicity studies have shown mixed results. Several commenters stated that no MCLG should be established for monochlorobenzene since the occurrence is very low and the health effects data are very weak.

Two commenters felt that the compound should be classified in Group D rather than Group C since the NTP bioassay detected only a small increase in liver tumors in male rats, with no effect in female rats or in male or female mice. One commenter supported the use of the subchronic study as the basis for the MCLG, while another commenter stated that a rabbit study could be used to calculate the MCLG.

**EPA response:** While it is true that older mutagenicity studies in plants showed positive results, the more recent studies in animals and microorganisms have been negative. Thus, EPA believes that it is accurate to state that mutagenicity studies have shown mixed results, but the preponderance of the evidence is negative. EPA believes that there is sufficient health effects information to support an MCLG for monochlorobenzene, since dose-response data are available from animal studies. EPA agrees that monochlorobenzene has not been found to be common in drinking water samples, but the potential for drinking water contamination exists since the compound has been identified at five hazardous waste sites. In addition, EPA is mandated by the SDWA Amendments to establish an MCLG for monochlorobenzene.

EPA agrees that monochlorobenzene should be classified in Group D for the reasons stated above. EPA does not agree that the rabbit study should be used to calculate the MCLG, since exposure was through the inhalation route, rather than ingestion.

**23. Polychlorinated biphenyls (PCBs).** In the November 1985 proposal, EPA proposed an MCLG of zero for PCBs based on sufficient evidence of carcinogenicity in animals (Group B2). No new data which change the conclusions presented in that notice have become available since its publication. EPA is therefore repropounding an MCLG of zero for PCBs.

**Science Advisory Board Comments:** EPA's Science Advisory Board (SAB) has stated that EPA should regulate PCBs by regulating the most toxic individual isomers. They have stated that a scale of toxicities for PCB isomers should be prepared and an "equivalency approach" developed, using the most toxic PCBs as the basis for comparison. EPA requests comments on this approach.

**Public comments:** Seven individuals or organizations commented on the MCLG proposal for PCBs. A number of commenters disagreed with the proposal of an MCLG of zero for PCBs for the following reasons:



- Inadequate evidence to classify PCBs as Category I carcinogens.
- Epidemiologic studies of exposed workers have not found significant cancer increases.
- The FDA allows a tolerance of 0.013 mg/day.
- Inadequate evidence of mutagenicity.
- Limited occurrence data.
- Analytical methods detect only some PCB isomers.
- The MCLG is unattainable.

Several commenters agreed that it is appropriate to set regulations for PCBs as a class of compounds, while one commenter stated that setting regulations for PCBs as a class is inappropriate because of significant health differences in isomers. Another commenter suggested that enforcement and treatment regulations should be based on those isomers with demonstrated adverse health effects.

**EPA response:** There are several animal studies which show PCB mixtures to be carcinogenic. As discussed in the November 1985 proposal, EPA believes these studies are sufficient to classify PCBs in Group B2, probable human carcinogen. EPA does not agree with the commenter that epidemiologic studies are negative. Three recently published epidemiologic studies of PCB-exposed populations reported statistically significant excesses of tumors of the lung, liver, gastrointestinal tract and hematopoietic system. However, these studies did not control for any potentially confounding factors and the number of exposed individuals was small. Thus, the epidemiologic data are suggestive, but are not conclusive in terms of PCBs as the sole etiologic agent for these types of cancer. Mutagenicity studies have shown mixed results, with some positive evidence; thus, EPA disagrees with the commenter's characterization of the mutagenicity evidence as inadequate. However, EPA has relied on the animal carcinogenicity data, not the mutagenicity data, in setting the MCLG for PCBs.

EPA does not believe that the FDA tolerance should be used as the basis for the MCLG, since FDA tolerances are developed for different uses and have a different basis from drinking water standards. The MCLG is based on health effects data only, and does not consider the availability of analytical methods or the feasibility of attaining the MCLG. EPA agrees that PCBs have not been found to have widespread occurrence in drinking water, but believes the evidence of adverse health effects and limited occurrence is sufficient to warrant an MCLG. In

addition, the SDWA Amendments direct EPA to set a regulation for PCBs.

The MCLG is a nonenforceable health goal, and thus the fact that zero is unattainable is not relevant to setting the MCLG.

EPA agrees that differences exist in health effects between the isomers but does not agree that the MCLG should be based on a specific isomer instead of on PCBs as a class of compounds. It would be impossible to regulate specific isomers since technical or commercial grade PCBs are mixed isomers from 10 classes of chlorobiphenyls containing 209 possible isomers.

**24. Pentachlorophenol.** EPA proposed an MCLG of 0.2 mg/l for pentachlorophenol in the November 1985 proposal. This was based upon an DWEL of 1 mg/l (rounded from 1.05 mg/l) calculated from a 24-month feeding study in rats with a NOAEL of 3 mg/kg/day, an uncertainty factor of 100 and a 20 percent drinking water contribution. Pentachlorophenol was classified in EPA's Group D. However, recent positive carcinogenicity data may lead to a revision of the MCLG.

The NTP recently completed a carcinogenicity bioassay on technical and purified commercial grades of pentachlorophenol in mice. The draft report [NTP Technical Report on the Toxicology and Carcinogenesis Studies of Pentachlorophenol (CAS no. 87-86-5) in B6C3F<sub>1</sub> Mice (Feed Studies); Draft Report, April, 1988] showed dose-related increases in three tumor types (hemangiosarcomas, adrenal pheochromocytomas, and carcinomas and adenomas) of the liver and adrenal tumors in males and females with both grades of the compound. EPA has concluded that this study would support reclassification of pentachlorophenol into Group B2 (sufficient evidence in animals) since the multiple tumor types at different dose levels in both sexes of mice satisfies the criteria for sufficient evidence for carcinogenicity in animals. Thus, EPA requests comment on an MCLG of zero for pentachlorophenol, based on the revised classification of B2 indicating sufficient evidence of carcinogenicity in animals.

**Public comments:** Six individuals or organizations commented on the MCLG proposal for pentachlorophenol. One commenter requested that EPA discuss the analytical procedures for the measurement of pentachlorophenol concentrations in drinking water in more detail. Another commenter asserted that some pentachlorophenol is present as a result of biodegradation of pesticides, that 97 percent of it is used for wood treatment, and that its use on wood is not recommended where it will come

into contact with potable water. One commenter noted a specific health effects study that should also be included in the Health Criteria Document, and discussed another study in which a low LD<sub>50</sub> value which was reported in the Health Criteria Document might possibly be due to dioxin or dibenzofuran contamination. The commenter stated that the probable cause of the toxicity was the fuel oil vehicle.

Several commenters stated that an MCLG should not be established for pentachlorophenol due to data which indicate that the health effects are based on furan and dioxin impurities in the pentachlorophenol, and the fact that the occurrence of pentachlorophenol in water is low. One commenter disagreed with the NOAEL of 3 mg/kg/day employed in the calculation of the MCLG.

**EPA response:** The analytical procedures for pentachlorophenol are discussed in more detail in Section IV. EPA agrees with the commenter's points on human exposure data on pentachlorophenol, i.e., that the occurrence of pentachlorophenol in rivers and streams comes from degradation products and that greater than 97 percent of pentachlorophenol is used in the treatment of wood. This information has been incorporated in EPA's report on the occurrence of pentachlorophenol.

EPA agrees with the commenter that the additional health effects study should be included in the Health Criteria Document and the fact that the fuel oil vehicle was a probable reason for the low LD<sub>50</sub>. This study and explanation have been added to the Health Criteria Document.

EPA believes that it is appropriate to set a standard for pentachlorophenol. 2,3,7,8-Tetrachlorodibenzo-p-dioxin was not detected in commercial pentachlorophenol used to set the MCLG. EPA agrees that occurrence and exposure data on pentachlorophenol are limited, but the compound has been detected in rivers and streams and pentachlorophenol has been identified at one hazardous waste site. In addition, the 1986 SDWA Amendments direct EPA to set an MCLG for this compound.

EPA disagrees with the commenter regarding the NOAEL of 3 mg/kg/day. No effects were seen in the Johnson et al. study [Johnson, R.L., Gehring, P.J., Kociba, R.J., and Schwetz, B.A. 1973. "Chlorinated Dibenzodioxins and Pentachlorophenol." *Environ. Health Perspec.*, Exp. Issue No. 5, Sept., 1973, pp. 171-175] at this dose level, while the 10 mg/kg/day dose produced increased



liver weights. EPA thus believes 3 mg/kg/day is an appropriate NOAEL.

25. *Styrene*: EPA proposed an MCLG of 0.14 mg/l for styrene in the November 1985 proposal. This was based upon a study in which beagle dogs were given styrene in a peanut oil suspension by gavage 7 days/week for up to 561 days. A NOAEL of 200 mg/kg/day was used with an uncertainty factor of 1,000, resulting in a DWEL of 7 mg/l. An additional uncertainty factor of 10 was applied because styrene was classified in EPA's Group C. Data which change the conclusions presented in that notice have become available and styrene has been reclassified in EPA's Group B2. The EPA Science Advisory Board (SAB) reviewed the Drinking Water Health Criteria Document for Styrene (February 4-5, 1988) and provided written review comments (July 19, 1988). The extensive SAB review comments are currently being considered by the EPA. After consideration of the SAB review and public comment, the EPA will reexamine this decision. Since the final cancer group classification of styrene is still under consideration at the present time, the EPA is proposing MCLGs of 0.1 mg/l (based on a group C classification) and zero (based on a Group B2 classification) and requests public comments on both proposed MCLGs.

The reclassification to Group B2 is based on reevaluation of animal bioassay data as well as new metabolism and genotoxicity data. The SAB does not agree that there is sufficient evidence to justify the reclassification of styrene to EPA Group B2 and recommends continuation of the Group C classification. The EPA recognizes that the Group B2 classification is a matter for further consideration within the Agency as well as by the public, due to different views on interpretation of the animal bioassay data. For example, the comparison of exposed animals to concurrent controls versus historical control data can result in different levels of statistical significance. Another critical issue affecting the classification of styrene is the degree of emphasis to place on supporting metabolism and genotoxicity data. For example, there is a wide range of opinions regarding the relevance of low levels of a carcinogenic metabolite (styrene-7,8-oxide) in humans exposed to styrene. The final outcome of reviews of supporting data will influence the weight-of-the-evidence approach detailed in the EPA's Guidelines for Carcinogen Risk Assessment.

The evidence from animal cancer bioassays indicated an elevated incidence of tumors in both rats and

mice. In one study (Ponomarev, V., and Tomatis, L. 1978. "Effects of Long-term Oral Administration of Styrene to Mice and Rats. *Scand. J. Work Environ. Health*. 4(Suppl. 2):127-135), an increased incidence of lung tumors was observed in male and female O<sub>20</sub> mice. Also, an increased incidence of liver carcinomas was shown in male C57B1 mice administered styrene by gavage. In the National Cancer Institute (NCI) bioassay of styrene, when study controls are considered, a statistically significant increase in lung tumors was seen in male B6C3F1 mice with a positive dose-response trend (NCI Technical Report Series No. 185, 1979). In an inhalation study [Jersey, G.C., et al. 1978. "Two-Year Chronic Inhalation Toxicity and Carcinogenicity Study on Monomeric Styrene in Rats." Dow Chemical Study for Manufacturing Chemists Association. Dec. 6, 1978] the incidence of mammary adenocarcinomas was elevated in female Sprague-Dawley rats.

The EPA Guidelines for Carcinogenic Risk Assessment encourage the use of additional considerations to support or limit the strength of the bioassay evidence. In the case of styrene, the evidence for genotoxicity in short-term animal tests and in humans occupationally exposed to the chemical along with recent data on the metabolite styrene-7,8-oxide is considered supportive of carcinogenic potential.

The new metabolism and genotoxicity data indicate that styrene-7,8-oxide is the initial metabolite of styrene in humans and animals and that it is a potent animal carcinogen. A recent study demonstrated the presence of styrene-7,8-oxide in the blood of workers exposed to styrene in glass fiber-reinforced plastic factories. Supporting studies show protein and DNA adduct formation in various mouse tissues following styrene and styrene-7,8-oxide exposure. Covalent binding of styrene-7,8-oxide was demonstrated in mouse DNA from liver, lung and brain.

EPA previously classified styrene in Group C based upon the limitations of the animal cancer bioassays and supporting data. However, EPA now believes that these animal studies, when considered together with the new metabolism and genotoxicity data, may form a sufficient basis for classifying styrene in Group B2.

EPA requests comment on the possible health effects of styrene degradation products in water. Styrene is not stable under oxidizing conditions and converts to chlorostyrene and other degradation products in water containing chlorine. Any information on

these degradation products is requested. Comment is also requested on whether styrene should be classified as a Group C or Group B2 carcinogen based upon the considerations outlined above.

The Occupational Safety and Health Administration (OSHA) recently reviewed the carcinogenicity of styrene (54 FR 2429). In that *Federal Register* notice OSHA indicated its belief that the current evidence on styrene's carcinogenicity does not support its classification as a carcinogen. OSHA has reviewed additional evidence and has determined that the most appropriate basis for classifying styrene in its rulemaking is styrene's demonstrated narcotic effect. In its criteria document, the National Institute of Occupational Safety and Health (NIOSH) considers styrene primarily a narcotic and central nervous system toxin.

*Public comments*: Nine individuals or organizations commented on the MCLG proposal for styrene. One commenter agreed that styrene should be classified in Group C and that the DWEL was appropriate. One commenter stated that EPA has ample evidence to conclude that styrene is a potential human carcinogen. The other commenters stated that styrene should be deleted from the proposed regulation because the potential for occurrence is questionable, no occurrence data exist, styrene is very poorly soluble in water and the organoleptic threshold is lower than the adverse effect level.

*EPA response*: The final carcinogenicity classification of styrene is being reviewed as discussed above. Styrene has been found in both surface and ground water and in drinking water supplies. Additionally, EPA suspects styrene will be released into drinking water as a result of the use of certain resins for water treatment, and thus believes there is sufficient basis for establishing an MCLG. Furthermore, the 1986 SDWA amendments direct EPA to establish an MCLG for styrene.

Styrene has been detected in water, and thus EPA believes the solubility of the compound is not an issue. Regarding the organoleptic threshold, MCLGs are based on health effects only; secondary maximum contaminant levels are established to protect the aesthetic quality of water (including odor). EPA's proposed MCL of 0.1 mg/l is above the organoleptic threshold of 0.01 mg/l. Consequently, EPA is also proposing a secondary MCL of 0.01 mg/l.

26. *Tetrachloroethylene*. EPA first proposed an MCLG for tetrachloroethylene on June 12, 1984 (49 FR 24330). Assessments based on both



carcinogenic and noncarcinogenic effects were presented. EPA proposed an MCLG of zero based on carcinogenic potential, but recognized the available data indicated only "limited" evidence of carcinogenicity in animals. The assessment of carcinogenicity was based primarily on the 1977 NCI bioassay in which rats and mice were administered tetrachloroethylene via gavage. Mice showed an increased incidence of hepatocellular carcinoma. Data on rats were equivocal because of excessive mortality. A DWEL of 0.085 mg/l was also derived based on noncarcinogenic effects.

Public comments were received on the 1984 notice and the Agency response was published in the November 13, 1985 proposal. The 1985 proposal also included a reevaluation of the carcinogenicity classification. Both data from the 1977 NCI bioassay and a draft report on the 1985 NTP inhalation bioassay in rats and mice were available at that time. The inhalation bioassay also indicated that tetrachloroethylene caused an increased incidence of both hepatocellular carcinoma and adenoma in mice of both sexes. In addition, an increased incidence of mononuclear cell leukemia and renal tubular adenomas/carcinomas (combined) were observed in rats. The NTP had also repeated the gavage administration study in rats but this study was not validated following an extensive audit. On the basis of these data, EPA stated on November 13, 1985, that "sufficient" evidence of carcinogenicity in animals was available and recommended that tetrachloroethylene be classified in Group B2 (probable human carcinogen), according to the EPA cancer guidelines. Before reaching a final conclusion on the appropriate MCLG, EPA allowed an additional 45-day comment period for public comment on the draft NTP inhalation bioassay.

Prior to the November 1985 notice, both EPA's Risk Assessment Forum and Science Advisory Board (SAB) had concluded that available data were not adequate to support a classification of tetrachloroethylene as a probable human carcinogen (B2). However, neither group had the opportunity to review the draft 1985 NTP bioassay before publication of that notice. A review of the data on tetrachloroethylene, including the 1985 NTP inhalation bioassay, was subsequently conducted by the Halogenated Organics Subcommittee of the Science Advisory Board. The Subcommittee recommended that tetrachloroethylene be classified in

Group C: possible human carcinogen (U.S. EPA, Science Advisory Board: Environmental Health Committee Halogenated Organics Subcommittee report from N. Nelson and R. Griesmen to L. Thomas, January 27, 1987).

In August of 1987, the SAB's Halogenated Organics Subcommittee held a scientific workshop to discuss issues related to the toxicology of tetrachloroethylene (and other chemicals), such as the relevance of mouse liver tumors to human cancer risk. The SAB also examined the cancer classification of tetrachloroethylene and concluded that the overall weight of evidence lies on the continuum between EPA's Groups B2 and C (U.S. EPA, Science Advisory Board: Environmental Health Committee Halogenated Organics Subcommittee report from N. Nelson, R. Griesemer and J. Doull to L. Thomas, March 9, 1988).

EPA recognizes that, as with most chemicals, the evaluation of the carcinogenic potential of tetrachloroethylene in humans has its controversial elements. Because no scientific consensus yet exists, it is necessary for the Agency to make a judgment based on a reasonable weighing of evidence from the data at hand. In addition to the positive evidence provided by both the 1977 and 1985 carcinogenicity bioassays, weight of evidence consideration has been given to other factors as well. Mutagenicity, metabolites and their mutagenic/carcinogenic potential and data on the epidemiology of tetrachloroethylene were evaluated with respect to tetrachloroethylene carcinogenicity. The epidemiologic evidence is inadequate; the data are of insufficient quality to demonstrate either the presence or the absence of an effect. Metabolic considerations, however, provide some support for potential carcinogenicity since tetrachloroethylene epoxide, a reactive metabolite of tetrachloroethylene, has been found to be mutagenic and spent TCA, a major metabolite, and spent DCA, a minor metabolite, show both human promoting and complete carcinogenic properties in a mouse bioassay.

Mutagenicity data, in general, have been inconclusive or negative. Evidence of liver tumors in both sexes of mice by two routes of administration, evidence of mononuclear cell leukemia in rats, and evidence of renal adenomas/carcinomas in male rats, which is viewed as suggestive at present given the concerns about relevance to humans, along with supportive evidence of carcinogenic reactivity from metabolite considerations, and an

inadequate epidemiologic data base, provide a basis for classifying tetrachloroethylene in Group B2, probable human carcinogen, and establishing an MCLG of zero.

If one accepts a weighing of the evidence to be limited, along with the inadequate epidemiologic data base, tetrachloroethylene would be classified in Group C, possible human carcinogen. Under this classification, the MCLG would be 0.01 mg/l, calculated using a NOAEL of 20 mg/kg/day, based upon the absence of effects in mice (Buben and O'Flaherty, 1985. Delineation of the Role of Metabolism in the Hepatotoxicity of Trichloroethylene and Perchloroethylene. A Dose-Effect Study. *Toxicol. Appl. Pharm.* 73:105-122) and rats (Hayes et al. 1986. The Subchronic Toxicity of Tetrachloroethylene (Perchloroethylene) Administered in the Drinking Water of Rats. *Fundamental and Applied Toxicology* 7:119-125), an adjustment of 5/7 (since the dose was administered for 5 days per week), an uncertainty factor of 1,000, a 20 percent assumed contribution from drinking water and an additional uncertainty factor of 10, to account for the Group C classification.

EPA is proposing the MCLG for tetrachloroethylene at zero, based upon a Group B2 classification. However, the Agency will fully consider both approaches before promulgation. Comment is requested on both approaches.

27. *Toluene.* EPA proposed an MCLG of 2.0 mg/l for toluene in the November 13, 1985, notice, based on a NOAEL of 1130 mg/m<sup>3</sup> from animal studies. No new data which change the conclusions presented in that notice have become available since its publication. EPA is, therefore, repropounding an MCLG of 2 mg/l (rounded from 2.0 mg/l) for toluene.

*Public comments:* Five individuals or organizations commented on the MCLG proposal for toluene. All commenters disagreed with the proposed MCLG for toluene, asserting that the available occurrence data were inadequate. One of the commenters stated that the estimated 20 percent contribution of drinking water to total toluene exposure was overly conservative and arbitrary. One commenter stated that, based on occurrence data, a 10 percent contribution from drinking water should be assumed. Another commenter stated that there is no data correlating toluene in drinking water with adverse human health effects.

*EPA response:* EPA presented a summary of the occurrence data on toluene in the November 1985 notice.



While the levels of toluene in drinking water are generally below the proposed MCLG, toluene was found frequently in the water sampled; 20 percent of the samples in the National Screening Program (NSP) survey were positive for toluene. EPA believes the widespread use of petroleum products creates the potential for the occurrence of toluene in drinking water even though the historical occurrence is low. In addition, the 1986 Amendments to the SDWA require EPA to set an MCLG for toluene.

The basis for EPA's assumption that drinking water could contribute up to 20 percent of total toluene exposure is presented in Section III-B; no actual data on toluene exposures from other sources were submitted by the commenter. Thus, EPA believes a 20 percent contribution from drinking water is appropriate in the absence of specific data in accordance with the policy described earlier in this notice. EPA solicits any such data that may be available.

28. *Toxaphene*. EPA proposed an MCLG of zero for toxaphene in the November 1985 proposal. This was based upon data which indicate that toxaphene is a carcinogen in animals and thus is classified in Group B2. No new relevant data which change the conclusions presented in that notice have become available since its publication. EPA is, therefore, repropounding an MCLG of zero for toxaphene.

*Public comments:* Two individuals or organizations commented on the MCLG proposal for toxaphene. One commenter agreed with the proposal. The other commenter disagreed with EPA's assessment of toxaphene occurrence in water, stating that a recent survey of rural water sources contradicts the conclusion that significant occurrences of toxaphene contamination exist.

*EPA response:* EPA agrees that toxaphene was not detected in the Rural Water Survey and that occurrence appears to be minimal. However, EPA is required to prepare drinking water regulations for toxaphene under the 1986 SDWA Amendments.

29. *2,4,5-TP (Silvex)*. EPA proposed an MCLG of 0.052 mg/l for 2,4,5-TP in the November 1985 proposal. This was based upon a two-year feeding study in dogs in which 0.75 mg/kg/day was identified as the NOAEL [Mullison, 1968. South Weed Conf. Proc. 19th Annual Meeting, Jacksonville, FL, pp. 420-436]. Using an uncertainty factor of 100, a DWEL of 0.26 mg/l was calculated. No new relevant data which change the conclusions presented in that notice have become available since its publication. EPA is, therefore,

repropounding an MCLG of 0.05 mg/l, rounded from the proposed value of 0.052 mg/l.

*Public comments:* Five individuals or organizations commented on the MCLG proposal for 2,4,5-TP. One commenter noted that the Federal Register notice did not contain adequate details on the analytical methods for detection of 2,4,5-TP in drinking water. One commenter pointed out that 2,4,5-TP is not likely to occur in drinking water since most uses of 2,4,5-TP were suspended in 1979, all registrations have been voluntarily withdrawn or cancelled, and the period for limited use of existing stocks has expired. Three commenters recommended that 2,4,5-TP not be regulated because of its low occurrence. One commenter disagreed with the MCLG proposed by EPA, stating that a 20 percent drinking water contribution is not appropriate since there is little or no likelihood of exposure from food or air. One commenter questioned the rationale on why NAS used an uncertainty factor of 1,000, while EPA used an uncertainty factor of 100 for the same data.

*EPA response:* See Section IV for a discussion of the proposed analytical method for 2,4,5-TP. EPA agrees that occurrence of 2,4,5-TP is limited, but the compound has been found in drinking water supplies at hazardous waste sites and in waste water. Thus, EPA believes the potential exists for some occurrence and, under the provisions of the 1986 SDWA Amendments, EPA must set a drinking water regulation for 2,4,5-TP.

EPA believes that exposure data are inadequate to assess the contribution of 2,4,5-TP from the different sources (food and air) and thus believes it is appropriate to consider a 20 percent contribution from drinking water, according to the policy previously described. NAS did not provide a rationale for their selection of an uncertainty factor of 1,000; EPA's use of an uncertainty factor of 100 was consistent with its policy on the use of uncertainty factors based on a NOAEL from an animal study.

30. *Xylenes (total)*. EPA proposed an MCLG of 0.44 mg/l for xylenes in the November 1985 proposal. However, since that time new data have become available which change EPA's conclusions about xylene's toxicity. This notice will discuss only the new data and conclusions that have been changed since publication of that notice, resulting in a repropounded MCLG of 10 mg/l for xylenes. For the purposes of this proposal, xylenes are considered to be the mixture of three isomers, ortho-, meta-, and para-xylenes.

In the November 1985 proposal, EPA estimated a provisional DWEL for

xylenes based on an inhalation study using rats, guinea pigs, monkeys and dogs. The animals were exposed continuously for 90 days; an exposure level of 337 mg/m<sup>3</sup> was determined to be the NOAEL for xylenes based on this study. EPA applied an uncertainty factor of 1,000 (because few animals were used in the study), and assumed that an adult consumes two liters of water per day; this resulted in a DWEL of 2.2 mg/l. Finally, EPA assumed that 20 percent of xylenes exposure comes from drinking water; resulting in an MCLG of 0.44 mg/l.

EPA also evaluated the carcinogenic potential of xylenes in the November 1985 proposal. Few data were available; a carcinogenicity bioassay was at that time being conducted by the NTP although the data were not available. Xylenes were placed in Group D, based on inadequate animal data.

Since the November 1985 notice, the NTP bioassay (Toxicology and Carcinogenesis Studies of Xylenes, Technical Report No. 327, 1986) on xylenes in rats and mice has been completed and made available. The test compound contained p-xylene (13.6 percent), m-xylene (60.2 percent), o-xylene (9.1 percent) and ethylbenzene (17 percent). At no site was the incidence of neoplastic lesions in rats or mice of both sexes found to be related to the administration of xylenes. Xylenes are classified in Group D; EPA is presently reconsidering this classification and may change it to Group E (based upon the review of the bioassay results) at a later date.

Based on the NTP study, EPA is proposing a revised MCLG because this study was conducted by the oral route. It is therefore more representative of xylene's toxicity in drinking water than is the inhalation study which formed the basis for the MCLG in the November 1985 notice. The NTP study involved the administration of 0, 250, or 500 mg/kg xylenes in corn oil by gavage to groups of F344/N rats of each sex, 5 days per week for 103 weeks. Although the mortality was dose-related in male rats (final survival: vehicle control, 36/50; low dose, 26/50; high dose, 20/50), many of the early deaths in the dosed males were gavage related. Body weights of the high-dose (500 mg/kg) male rats were 5 to 8 percent lower than those of the vehicle controls after week 59. The mean body weights of low-dose and vehicle control male rats and those of dosed and vehicle control female rats were comparable. Survival rates of female rats were not significantly different from those of the vehicle controls. Using the 250 mg/kg dose



(adjusted by 5/7 because the dose was only administered for 5 days per week) of xylenes in rats as the NOAEL, and an uncertainty factor of 100, an RfD of 1.78 mg/kg/day has been calculated. A DWEL of 62 mg/l was calculated from the RfD value of 1.78 mg/kg/day, assuming that a 70-kg adult consumes 2 liters of water per day. The proposed MCLG of 10 mg/l (rounded from 12 mg/l) is based on the DWEL of 62 mg/l, assuming 20 percent of total exposure to xylenes is from drinking water sources.

**Public comments:** Four individuals or organizations commented on the MCLG proposal for xylenes. One commenter agreed with the proposal. One commenter disagreed with the assumed 20 percent contribution of drinking water to total xylenes exposure, asserting that it was an over-conservative and arbitrary figure and is inappropriate because the air concentration of xylenes is low and it is unlikely to contaminate food. Two commenters stated that xylenes will not have a significant impact asserting that it has only been found in drinking water following installation of floating covers which used adhesives in which xylenes were a solvent.

**EPA response:** There is at present inadequate data to characterize exposures to xylenes from food and air. In the absence of such data, EPA is assuming a 20 percent contribution from water, for the reasons outlined previously.

EPA agrees that xylenes have not been found to have widespread occurrence in drinking water, and thus many systems will not have to install treatment to meet the proposed standard. However, the 1986 SDWA Amendments require that a regulation be set for xylenes.

#### IV. Determination of Proposed MCLs

The MCLs being proposed by EPA are as follows:

TABLE 5.—PROPOSED MCLs

Compound	MCL (mg/l)
<b>Inorganics:</b>	
Asbestos <sup>1</sup> .....	7 Million fibers/liter.
Barium.....	5.
Cadmium.....	0.005.
Chromium.....	0.1.
Mercury.....	0.002.
Nitrate <sup>2</sup> .....	10 (as N).
Nitrite <sup>2</sup> .....	1 (as N).
Selenium.....	0.05.
<b>Organics:</b>	
Acrylamide.....	Treatment technique.
Alachlor.....	0.002.
Aldicarb.....	0.01.
Aldicarb sulfoxide.....	0.01.
Aldicarb sulfone <sup>2</sup> .....	0.04.
Atrazine.....	0.003.

TABLE 5.—PROPOSED MCLs—Continued

Compound	MCL (mg/l)
Carbofuran.....	0.04.
Chlordane.....	0.002.
Dibromochloropropane.....	0.0002.
o-Dichlorobenzene.....	0.6.
cis-1,2-Dichloroethylene.....	0.07.
trans-1,2-Dichloroethylene.....	0.1.
1,2-Dichloropropane.....	0.005.
2,4-D.....	0.07.
Epichlorohydrin.....	Treatment technique.
Ethylbenzene.....	0.7.
Ethylene dibromide.....	0.00005.
Heptachlor.....	0.0004.
Heptachlor epoxide.....	0.0002.
Lindane.....	0.0002.
Methoxychlor.....	0.4.
Monochlorobenzene.....	0.1.
PCBs (as Decachlorobiphenyl).....	0.0005.
Pentachlorophenol.....	0.2.
Styrene.....	<sup>2</sup> 0.005/0.1.
Tetrachloroethylene.....	0.005.
Toluene.....	2.
Toxaphene.....	0.005.
2,4,5-TP (Silvex).....	0.05.
Xylenes (total).....	10.

<sup>1</sup> MCL for fibers exceeding 10  $\mu$ m in length.

<sup>2</sup> MCL for total nitrate and nitrite=10.0 mg/l (as N).

<sup>3</sup> EPA proposes an MCL of 0.1 mg/l based upon a Group C classification and an MCL of .005 based on a B<sub>2</sub> classification.

As noted earlier, the SDWA directs EPA to set the MCL "as close to" the MCLGs "as is feasible." The term, "feasible," means "feasible with the use of the best technology, treatment techniques, and other means, which the Administrator finds, after examination for efficacy under field conditions and not solely under laboratory conditions, are available (taking costs into consideration)." SDWA section 1412(b)(5). Each national primary drinking water regulation which establishes an MCL must list the technology, treatment techniques, and other means which the Administrator finds to be feasible for meeting the MCL (SDWA section 1412(b)(6)).

The present statutory standard for "best available technology" (BAT) under 1412(b)(5) represents a change from the provision prior to 1986, which required EPA to judge feasibility on the basis of "best technologies generally available" ("BTGA"). The 1986 amendments to the SDWA changed BTGA to BAT and added the requirement that BAT must be tested for efficacy under field conditions, not just under laboratory conditions. The legislative history explains that Congress removed the term, "generally" to assure that MCLs "reflect the full extent of current technology capability." (S. Rep. No. 56, 99th Cong., 1st Sess. at 6 (1985)). Read

together with the legislative history, EPA has concluded that the statutory term, "best available technology," is a broader standard than "best technology generally available" and that this standard allows EPA to select a technology that is not necessarily in widespread use, as long as it has been field tested beyond the laboratory. In addition, EPA believes this change in the statutory requirement means that the technology selected need not necessarily have been field tested for each specific contaminant. Rather, EPA may project operating conditions for a specific contaminant using a field tested technology from laboratory or pilot systems data.

Based on the statutory directive for setting the MCLs, EPA derives the MCLs based on an evaluation of (1) the availability and performance of various technologies for removing the contaminant, and (2) the costs of applying those technologies. Other factors which are considered in determining the MCL include the ability of laboratories to measure accurately and consistently the level of the contaminant with available analytical methods. For carcinogens the Agency also evaluates the health risks that are associated with various levels of the contaminants with the goal of ensuring that the risks at the MCL fall within the  $10^{-4}$  to  $10^{-6}$  risk range that the Agency considers protective of public health and therefore achieves the overall purpose of the SDWA.

EPA's initial step in deriving the MCL is to make an engineering assessment of technologies which are capable of removing a contaminant from drinking water. This assessment determines which of those technologies are "best." EPA reviews the available data to determine technologies which have the highest removal efficiencies, are compatible with other water treatment processes, and are not limited to a particular geographic region. A detailed discussion of EPA's engineering assessment of the available technologies for treating each contaminant and the proposed BAT(s) is contained in Section IV-B below.

Based on the removal capabilities of the various technologies, EPA calculates the level of each contaminant that is achievable by their application to relatively clean raw water sources. (See H.R. Rep. 1185, 93rd Cong., 2nd Sess. at 13 (1974); 132 Cong. Rec. S6287, May 21, 1986, statement of Sen. Durenberger.)

When considering costs, EPA decides whether the technology is reasonably affordable by regional and large metropolitan public water systems. This



standard was established when the SDWA was enacted in 1974 (see H.R. Rep. No. 93-1185 at 18 (1974)) and reaffirmed when the Act was amended in 1986 (see 132 Cong. Rec. S6287 (May 21, 1986) (statement of Sen. Durenberger)). EPA also evaluates the total national compliance costs. This evaluation considers the number of systems that will have to install treatment in order to comply with the MCL. The resulting national costs vary depending upon the concentration level chosen as the MCL. The lower the MCL, the greater the number of systems that may have to install BAT in order to achieve compliance. EPA believes that national costs should be considered by the Agency as part of its determination of what MCL level is "feasible".

The feasibility of setting the MCL at a precise level is also influenced by laboratory ability to measure reliably for the contaminant. EPA derives practical quantitation levels (PQLs) which reflect the level that can be measured by good laboratories under normal operating conditions within specified limits of precision and accuracy. (A detailed explanation of the PQL is contained in section IV-A, below.) Because compliance with the MCL is determined by analysis with approved analytical techniques, the ability to analyze consistently and accurately for a contaminant at the MCL is important to enforce a regulatory standard. Thus, the feasibility of meeting a particular level is affected by the ability of analytical methods to determine with sufficient precision and accuracy whether such a level is actually being achieved. This factor is critically important in determining the MCL for contaminants for which EPA proposes to set the MCLG at zero, a number which by definition cannot be measured. Limits of analytical detection require that the MCL be set at some

level greater than the MCLG for these contaminants. In these cases, EPA examines the reduction capability of BAT and the accuracy of analytical techniques as reflected in the PQL to determine the appropriate MCL level.

EPA also evaluates the health risks that are associated with various contaminant levels in order to insure that the MCL adequately protects the public health. For drinking water contaminants, EPA sets a reference risk range for carcinogens at  $10^{-4}$  to  $10^{-5}$  excess individual risk from lifetime exposure. Most regulatory actions in a variety of EPA programs generally target this range using conservative models which are not likely to underestimate the risk. Since the underlying goal of the Safe Drinking Water Act is to protect the public from adverse effects due to drinking water contaminants, EPA seeks to insure that the health risks associated with MCLs for carcinogenic contaminants are not significant.

Below is a detailed discussion of the Agency's derivation of the proposed MCLs.

#### A. Analytical Methods

The SDWA directs EPA to set an MCL for a contaminant "if, in the judgment of the Administrator, it is economically and technologically feasible to ascertain the level of such contaminant in water in public water systems." (SDWA section 1401(1)(C)(ii)). To make this threshold determination for contaminants proposed today, EPA evaluated the availability, costs, and the performance of analytical techniques which measure drinking water contaminants. This evaluation is discussed below. EPA also considered the ability of laboratories to measure consistently and accurately for a contaminant (i.e., the PQL) to determine the appropriate MCL.

The reliability of analytical methods is critical at the maximum contaminant level. Therefore, each analytical method was evaluated for accuracy or recovery (lack of bias) and precision (good reproducibility) at the MCL range(s). The primary purpose of this evaluation is to determine:

- Whether analytical methods exist to measure drinking water contaminants;
- Reasonable expectations of technical performance by analytical laboratories at the MCL level(s); and
- Analytical costs.

The selection of analytical methods considers the following factors:

- (a) Reliability (i.e., precision/accuracy) of the analytical results;
- (b) Specificity in the presence of interferences;
- (c) Availability of enough equipment and trained personnel to implement a national monitoring program (i.e., laboratory availability);
- (d) Rapidity of analysis to permit routine use; and
- (e) Cost of analysis to water supply systems.

#### 1. Inorganic Chemicals

Analytical methods exist to measure each inorganic contaminant covered by today's proposed rule. Table 6 lists the analytical methods currently approved for the inorganics (see 40 CFR Part 141, Subpart C). The analytical methods listed in Table 6 have been used for many years to determine compliance with the current MCLs.

Table 7 lists the analytical methods that EPA is proposing today to comply with the proposed monitoring requirements. EPA has updated the original references to the most recent editions of the manuals including the atomic absorption methods for metals, and the colorimetric, spectrophotometric and potentiometric methods for nitrate.

TABLE 6.—CURRENTLY APPROVED METHODOLOGY FOR INORGANIC CONTAMINANTS

Contaminant	Methodology <sup>7</sup>	EPA <sup>1</sup>	Reference (Method Number)		
			ASTM <sup>2</sup>	SM <sup>3</sup>	Other
Barium.....	Atomic absorption; direct aspiration.....	208.1		301A-IV	
	Atomic absorption; furnace technique.....	208.2			
	Inductively-coupled plasma.....	200.7A <sup>6</sup>			
Cadmium.....	Atomic absorption; direct aspiration.....	213.1	D3557-78A or B	301A-II or III	
	Inductively-coupled plasma.....	200.7A <sup>6</sup>			
	Atomic absorption; furnace technique.....	213.2			
Chromium.....	Atomic absorption; direct aspiration.....	218.1	D1687-77D	301A-II or III	
	Atomic absorption; furnace technique.....	218.2			
	Inductively-coupled plasma.....	200.7A <sup>6</sup>			
Mercury.....	Manual cold vapor technique.....	245.1	D3223-79	301A-VI	
	Automated cold vapor technique.....	245.2			
Nitrate.....	Colorimetric brucine <sup>8</sup> .....	352.1	D992-71	419D	



TABLE 6.—CURRENTLY APPROVED METHODOLOGY FOR INORGANIC CONTAMINANTS—Continued

Contaminant	Methodology <sup>1</sup>	EPA <sup>1</sup>	Reference (Method Number)		
			ASTM <sup>2</sup>	SM <sup>3</sup>	Other
Selenium	Spectrometric; cadmium reduction.....	353.3	D3867-79B	419C	
	Automated hydrazine reduction.....	353.1			
	Automated cadmium reduction.....	353.2	D3867-79A	605	
	Ion selective electrode.....			93MM-79 <sup>5</sup>	
	Ion chromatography.....	300.0			
	Atomic absorption; furnace technique.....	270.2			
	Atomic absorption; gaseous hydride.....	270.3	D3859-79	301A-VII	1-3667-78 <sup>4</sup>

<sup>1</sup> "Methods of Chemical Analysis of Water and Wastes," EPA Environmental Monitoring and Support Laboratory, Cincinnati, OH 45268 (EPA-600/4-79-020), March 1979. Available from ORD Publications, CERL, EPA, Cincinnati, OH 45268.

<sup>2</sup> Annual Book of ASTM Standards, Part 31 Water, American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

<sup>3</sup> "Standard Methods for the Examination of Water and Wastewater," 14th edition, American Public Health Association, American Water Works Association, Water Pollution Control Federation, 1975.

<sup>4</sup> Techniques of Water Resources Investigation of the U.S. Geological Survey, Chapter A-1, "Methods for Determination of Inorganic Substances in Water and Fluvial Sediments," Book 5 (1979, Stock #024-001-03177-9). Available at Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

<sup>5</sup> "Methods Manual—93 Series Electrodes," Form 93 MM/9790, pp. 3-6, 1979. Orion Research Inc., Cambridge, MA.

<sup>6</sup> "Inductively-Coupled Plasma Atomic Emission Analysis of Drinking Water," Appendix to Method 200.7, March 1987, U.S. EPA, Environmental Monitoring and Support Laboratory, Cincinnati, OH 45268.

<sup>7</sup> For approved analytical procedures for metals, the technique applicable to total metals must be used.

<sup>8</sup> EPA is proposing to delete this method.

TABLE 7.—PROPOSED METHODOLOGY FOR INORGANIC CONTAMINANTS

Contaminant	Methodology <sup>1,1</sup>	EPA <sup>1</sup>	Reference (Method Number)		Other
			ASTM <sup>2</sup>	SM <sup>3</sup>	
Asbestos	Transmission Electron Microscopy.....	EPA <sup>9</sup>			
Barium	Atomic absorption; furnace technique.....	208.2		304	
	Atomic absorption; direct aspiration.....	208.1		303C	
	Inductively-coupled plasma.....	200.7A <sup>6</sup>			
	Atomic absorption; furnace technique.....	213.2		304	
Cadmium	Inductively-coupled plasma.....	200.7A <sup>6</sup>			
	Atomic absorption; furnace technique.....	218.2		304 <sup>7</sup>	
Chromium	Inductively-coupled plasma.....	200.7A <sup>6</sup>			
	Manual cold vapor technique.....	245.1	D3223-80	303F	
	Automated cold vapor technique.....	245.2			
Mercury	Atomic absorption; furnace technique.....	353.3	D3867-85B	418C	
	Automated hydrazine reduction.....	353.1			
Nitrate	Automated cadmium reduction.....	353.2	D3867-85A	418F	
	Ion selective electrode.....				WeWWG/ 5880 <sup>5</sup> B-1001 <sup>10</sup>
	Ion chromatography.....	300.0			
	Spectrophotometric.....	354.1			
Nitrite	Automated cadmium reduction.....	353.2	D3867-85A	418F	
	Manual cadmium reduction.....	353.3	D3867-85B	418C	
	Ion chromatography.....	300.0			B-1011 <sup>10</sup>
	Atomic absorption; gaseous hydride.....	270.3	D3859-84A	303E	I-3667-85 <sup>4</sup>
Selenium	Atomic absorption; furnace technique.....	270.2	D3859-84B	304 <sup>8</sup>	

<sup>1</sup> "Methods of Chemical Analysis of Water and Wastes," EPA Environmental Monitoring and Support Laboratory, Cincinnati, OH 45268 (EPA-600/4-79-020), March 1983. Available from ORD Publications, CERL, EPA, Cincinnati, OH 45268.

<sup>2</sup> Annual Book of ASTM Standards, Vol. 11.01, American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

<sup>3</sup> "Standard Methods for the Examination of Water and Wastewater," 16th edition, American Public Health Association, American Water Works Association, Water Pollution Control Federation, 1985.

<sup>4</sup> "Methods for Determination of Inorganic Substances in Water and Fluvial Sediments," Techniques of Water-Resources Investigations of the U.S. Geological Survey Books, Chapter A1, 1985, Open-File Report 85-495. Available from Open-File Services Section, Western Distribution Branch, U.S. Geological Survey, MS 306 Box 24525, Denver Federal Center, Denver, CO 80225.

<sup>5</sup> "Orion Guide to Water and Wastewater Analysis," Form WeWWG/5880, p. 5, 1985. Orion Research, Inc., Cambridge, MA.

<sup>6</sup> "Inductively-Coupled Plasma Atomic Emission Analysis of Drinking Water," Appendix to Method 200.7, March 1987, U.S. EPA, Environmental Monitoring and Support Laboratory, Cincinnati, OH 45268.

<sup>7</sup> The addition of 1 mL of 30% H<sub>2</sub>O<sub>2</sub> to each 100 mL of standards and samples is required before analysis.

<sup>8</sup> Prior to dilution of the Se calibration standard, add 2 mL of 30% H<sub>2</sub>O<sub>2</sub> for each 100 mL of standard.

<sup>9</sup> "Analytical Method for Determination of Asbestos Fibers in Water," EPA-600/4-83-043, September 1983, U.S. EPA, Environmental Research Laboratory, Athens, GA 30613.

<sup>10</sup> "Waters Test Method for the Determination of Nitrite/Nitrate in Water Using Single Column Ion Chromatography," Method B-1011, Millipore Corporation, Waters Chromatography Division, 34 Maple Street, Milford, MA 01757.

<sup>11</sup> For approved analytical procedures for metals, the technique applicable to total metals must be used.

EPA is proposing to withdraw its approval of the colorimetric brucine method for nitrate because strict controls are necessary in the heating step, resulting in high data variability. Both the American Society for Testing and Materials and "Standard Methods" discontinued publication of this method.

In addition to those analytical methods approved for compliance with the current inorganic MCLs, a new analytical technique, ion chromatography developed by the Millipore Corporation, is available. Ion chromatography is used to analyze nitrate. It uses an ultraviolet detector

and a single column. Comparability data has been gathered on both the Millipore Corporation method and on EPA's Method 300.0 (ion chromatography based method). The comparability data indicate that these two analytical techniques are comparable in terms of precision and accuracy. The study



report is in the docket for this proposed rule. Public comments are requested on whether EPA should approve the Millipore analytical method for nitrate analysis.

EPA is proposing MCLs for two inorganic contaminants, nitrite and asbestos, not previously regulated. EPA is proposing four analytical methods to determine nitrite using the spectrophotometric, colorimetric or ion chromatography techniques. These methods have been available for some time and use procedures similar to those used for nitrate analyses. EPA also evaluated existing analytical methods for asbestos and determined that transmission electron microscopy (TEM) is the best available technique. However, some major drawbacks of TEM exist. They are: (1) The initial capital outlay is expensive for many laboratories (in the order of \$200,000 for equipment), (2) the analytical cost may run from \$300 to \$500 per sample, (3) analysis requires specialized facilities and highly trained personnel, and (4) currently the availability of equipped laboratories is limited. The compliance monitoring requirements proposed later in this rule reflect these limitations. EPA believes that sufficient analytical capacity will exist for those water systems that are vulnerable to asbestos contamination to conduct monitoring in the time frame specified in the proposed rule.

EPA has determined that the analytical methods listed in Table 7 are technically and economically available for inorganic monitoring. The analytical costs associated with analyzing the metals (barium, cadmium, chromium, mercury and selenium) and the inorganic anions (nitrate and nitrite) are \$20 to \$30 per metal per sample and \$10 to \$20 per nitrate/nitrite sample. EPA believes these analytical costs are affordable. (The actual analytical costs may vary with the laboratory, analytical technique selected, the total number of samples and other factors.) The number of laboratories that routinely participate in EPA's Water Supply and Water Pollution performance evaluation studies indicates that many laboratories having the capability to conduct analysis for the metals and nitrate/nitrite exist. Furthermore, EPA believes that it is economically and technologically feasible for systems to monitor for asbestos as prescribed in the proposed rule. To ensure that enough laboratories exist to analyze for asbestos, EPA is proposing that public water systems have five years from publication of the final rule to complete

the asbestos monitoring. [See section on Compliance Monitoring Requirements.]

Below is a description of the proposed techniques. For precision and accuracy information on the proposed analytical methods, EPA refers readers to the references listed in Table 7. EPA requests public comments on the technical adequacy of the proposed analytical techniques.

**a. Metals—Atomic Absorption Methods**—Metals in solution may be determined by atomic absorption spectroscopy. There are two techniques that may be used: direct aspiration (AA) and the graphite furnace technique (GFAA). In direct aspiration, the sample is aspirated into a flame and atomized. A light beam is directed through the flame into a monochromator and onto a detector that measures the amount of light absorbed by the atomized element in the flame. Because each metal has its own characteristic absorption wavelength, a source lamp composed of that element is used. This makes the method relatively free from spectral or radiation interferences. The amount of energy of the characteristic wavelength absorbed in the flame is proportional to the concentration of the element in the sample. In the furnace technique, a sample is placed in the graphite tube in the furnace, evaporated to dryness, charred and atomized. As a greater percentage of the available analyte atoms are vaporized and dissociated for absorption in the graphite tube, lower concentrations may be determined.

Atomic absorption is applicable to the determination of barium, cadmium, chromium, mercury and selenium. The specific requirements for analyzing these metals using atomic absorption techniques vary with the metal and/or the concentration. When the direct aspiration atomic absorption technique does not provide adequate sensitivity (in addition to the furnace technique), other specialized procedures are available. The determination of selenium is achieved by conversion to its hydrides prior to aspiration into an argon-hydrogen flame. The determination of cadmium and chromium at low concentrations requires a chelation with ammonium pyrrolidine dithiocarbamate and extraction into methyl isobutyl-ketone prior to aspiration into an air-acetylene flame. Determination of mercury is by a cold vapor technique.

**Inductively-Coupled Plasma (ICP)—Atomic Emission Spectrometric Method (ICP-AES)**—This method (also known as "EPA Method 200.7") describes a technique for the simultaneous or sequential multi-element determination of trace elements in solution. This

method applies to three metals included in this proposal: barium, cadmium, and chromium. The method measures atomic emissions by an optical spectroscopic technique. Samples are nebulized and the aerosol that is produced is transported to the plasma torch where excitation occurs. Characteristic line emission spectra are produced by a radio frequency ICP. The spectra are dispersed by a grating spectrometer and the intensities of the lines are monitored by photomultiplier tubes. The photocurrents from the photomultiplier are processed and controlled by a computer system. A background correction technique is required to compensate for variable background contribution to determine trace elements. Background levels must be measured adjacent to analyte lines on samples during the analysis.

The appendix to Method 200.7 entitled, "Inductively Coupled Plasma—Atomic Emission Analysis of Drinking Water" must be followed in processing drinking water supply samples prior to ICP emission spectrometric analysis. This appendix describes a technique for concentrating the sample prior to analysis. Method 200.7 is not sensitive enough for the analysis of cadmium samples at the MCL level proposed in this rule unless samples containing this element are concentrated prior to analysis. This concentration technique improves the sensitivity of ICP to other elemental contaminants as well.

**b. Anions (Nitrate and Nitrite)—Manual Cadmium Reduction**—This method is used to analyze nitrite or combined nitrite/nitrate. For combined nitrite and nitrate, the sample is passed through a column containing granulated copper-cadmium to reduce nitrate to nitrite. The nitrite is determined by diazotizing with sulfanilamide and coupling with N-(1-naphthyl)ethylenediamine dihydrochloride to form a highly colored azo dye which is measured spectrophotometrically. Carrying out this procedure first with, and then without, the copper-cadmium reduction step permits the calculation of the nitrate value by subtracting the combined nitrite/nitrate measurement.

**Automated Cadmium Reduction**—This method is similar to the manual cadmium reduction method except that the azo dye is measured colorimetrically using an automated procedure.

**Automated Hydrazine Reduction**—This method is used to determine combined nitrite/nitrate in drinking water samples. Nitrate is reduced to nitrite with hydrazine sulfate and the nitrite is determined by diazotizing with



sulfanilamide and coupling with N-(1-naphthyl)ethylenediamine dihydrochloride to form a highly colored azo dye which is measured colorimetrically.

**Ion Selective Electrode**—This method is used to determine nitrate. The nitrate electrode consists of an electrode body and a replaceable pretested sensing module. The sensing module contains a liquid internal filling solution in contact with a gelled organophilic membrane containing a nitrate ion-selective ion exchanger. When the membrane is in contact with a nitrate solution, an electrode potential develops across the membrane. This potential, which depends on the level of free nitrate ion in solution, is measured against a constant reference potential with a digital pH/mV meter or specific ion meter.

**Ion Chromatography Method**—This method is used to determine nitrite and nitrate. A small volume of the sample is introduced into an ion chromatograph. The separation of ions is based on their relative affinities for a low capacity, strongly basic anion exchanger (guard and separator column). The separated anions are then directed onto a strongly acidic cation exchanger (suppressor column) where they are converted to their highly conductive acid form. Detection of ionic species is carried out by monitoring the electrical conductivity in a micro cell. The separated species are identified on the basis of retention times as compared to standards. Quantitation is by measurement of peak area or peak height. The response given by an ion is a function of its ionic conductivity and identification is a function of its order of elution from the column.

Another ion chromatographic method for determining nitrite and nitrate in drinking water was recently developed by the Millipore Corporation. Instead of a conductivity detector and dual columns used in the EPA method (one of which acts as a suppressor column), this method uses an ultraviolet detector and a single column (with electronic suppression). Precision and accuracy data from a single laboratory were gathered for nitrate. Nine replicates of a drinking water sample containing 10 mg/l of nitrate were analyzed. The accuracy measured by the percent recovery was 101 percent and the precision measured by the relative standard deviation was 2 percent.

Millipore Corporation data for the single column method was analyzed and compared to the approved EPA Method 300.0. For five samples data were provided for the EPA Method 300.0 and the proposed single column method.

Statistical data analysis which compared the precision and accuracy of both methods indicated that for four of the five samples no statistically significant differences in precision existed. For the remaining sample, the Millipore method was significantly more precise than the EPA Method 300.0. Though there were some statistical differences in recoveries between the Millipore Corporation and EPA Method 300.0 methods, for four of five drinking water samples, the differences were extremely small compared with the nitrate concentrations tested. The recovery data from the remaining sample showed no statistical difference between the two methods.

**Spectrophotometric**—This method is used to determine nitrite. The nitrite is analyzed by diazotizing with sulfanilamide. The diazonium compound thus formed is coupled with N-(1-naphthyl)ethylenediamine dihydrochloride to produce a reddish-purple colored azo dye which is measured in a spectrophotometer at 540 nm.

**c. Asbestos—Transmission Electron Microscopy**—This method is used to determine the number of asbestos fibers per liter, fiber size (length and width), size distribution and the total mass. This method also distinguishes between chrysotile and amphibole asbestos. In this method, a variable known volume of water sample is filtered through a 0.1 micrometer filter to trap asbestos fibers and the filter is then carbon coated. A small portion of the carbon coated filter with deposited fibers is placed on an electron microscope grid and the filter material is removed by gentle solution in organic solvent. The material remaining on the electron microscope grid is examined in a transmission electron microscope (TEM). The asbestos fibers are identified by their morphology and electron diffraction patterns and their lengths and widths measured. The elemental composition is determined by energy dispersive x-ray analysis. This technique is very useful in the verification of asbestos fibers since it quickly distinguishes between asbestos and non-asbestos fibers. The concentration in million fibers per liter (MFL) is calculated by counting the fibers, calculating the amount of filtered water, and determining the ratio of the total filtered area to the sample filter area.

## 2. Synthetic Organic Chemicals

Numerous analytical techniques exist to determine volatile synthetic organic chemicals (VOCs) and other synthetic organic chemicals such as pesticides and polychlorinated biphenyls (PCBs).

These methods generally involve the use of a gas chromatograph (GC) or a high pressure liquid chromatograph (HPLC) with either conventional detectors or a mass spectrometer.

**a. Volatile Organic Chemicals (VOCs).** Five analytical methods for VOC analyses exist. EPA believes these methods are economically and technologically feasible for determining compliance with one or more of the proposed VOC MCLs. The five methods are specified below:

(1) U.S. EPA Method 502.1, "Volatile Halogenated Organic Compounds in Water by Purge and Trap Gas Chromatography"

(2) U.S. EPA Method 502.2, "Volatile Organic Compounds in Water by Purge and Trap Capillary Gas Chromatography with Photoionization and Electrolytic Conductivity Detectors in Series"

(3) U.S. EPA Method 503.1, "Volatile Aromatic and Unsaturated Organic Compounds in Water by Purge and Trap Gas Chromatography"

(4) U.S. EPA Method 524.1, "Volatile Organic Compounds in Water by Purge and Trap Gas Chromatography/Mass Spectrometry"

(5) U.S. EPA Method 524.2, "Volatile Organic Compounds in Water by Purge and Trap Capillary Column Gas Chromatography/Mass Spectrometry"

These five methods were approved for the analysis of the eight regulated VOCs and unregulated VOCs promulgated in July, 1987 (see 52 FR 25714, July 8, 1987). The VOCs in this proposed rule (cis-1,2-dichloroethylene, 1,2-dichloropropane, monochlorobenzene, o-dichlorobenzene, styrene, tetrachloroethylene, toluene, trans-1,2-dichloroethylene, ethylbenzene, and xylene) were included in the monitoring requirements for unregulated VOCs in the 1987 rule. EPA refers readers to that rule for specific information on laboratory availability, method specificity in the presence of interferences, rapidity, and analytical costs. EPA believes that the analytical methods listed above are technically and economically available for routine use. The incremental analytical costs to analyze the proposed VOCs will be minimal since systems are already required to monitor for the original eight VOCs by using the same analytical techniques.

Each of the five methods require headspace-free water samples. The volatiles from these samples are stripped by an inert gas that flows into a trapping column where they are adsorbed. The compounds are thermally desorbed from the column and backflushed onto the head of a GC.



column. This is followed by the separation of constituents in the GC column and measurement with a specific detection system.

Method 502.1 recommends the use of a column containing 1% SP-1000 on Carbowax-B for the separation of constituents that are detected with a halide specific detector (HSD). Either an electrolytic conductivity detector (ELCD) or a microcoulometric detector are recommended for separation. This method may be used to determine halogenated VOCs. The single laboratory accuracy and precision were determined by analyzing replicate samples of finished drinking water and raw source water spiked at levels of 0.2 or 0.4 µg/l. The accuracy, expressed as average percent recoveries, ranged from 85 to 110 percent and the precision, expressed as percent relative standard deviations, ranged from 3.5 to 20 percent.

Method 502.2 also recommends the use of a VOCOL wide-bore capillary column to separate constituents. These constituents are detected with a photoionization detector and a halide specific detector in series. Precision and accuracy of this method is similar to Methods 502.1 and 503.1. The single laboratory accuracy and precision were determined by analyzing reagent water spiked at 10 µg/l. The results using the photoionization detector show the accuracy expressed as average recoveries ranged from 93 to 109 percent, and the precision expressed as relative standard deviations ranged from 0.8 to 9.5 percent. Using the Hall electrolytic conductivity detector, average recoveries ranged from 86 to 109 percent and relative standard deviations ranged from 1.5 to 8.3 percent.

Method 503.1 recommends using a column containing 5 percent SP-1200+1.79% Bentone 34 on Supelcoport to separate constituents which are then analyzed with a photoionization detector (PID). This method may be used to analyze aromatic and unsaturated VOCs. The single laboratory accuracy and precision were determined by analyzing replicate samples of finished drinking water and raw source waters spiked at levels of 0.4 or 0.5 µg/l. The accuracy, expressed as average percent recoveries, ranged from 74 to 100 percent and the precision expressed as percent relative standard deviations ranged from 2.8 to 16.8 percent.

Method 524.1 recommends the use of a column containing one percent SP-1000 on Carbowax B to separate constituents detected with a mass spectrometer. VOCs are identified by comparing their mass spectra to the spectra of standards analyzed under identical conditions.

Each VOC in this proposed rule can be analyzed using this method. The single laboratory accuracy and precision were determined for various VOCs by analyzing replicate samples of reagent water spiked at levels of 1 to 5 µg/l. The accuracy expressed as average percent recovery ranged from 90 to 113 percent and the precision expressed as percent relative standard deviations ranged from 3.4 to 18.2 percent.

Method 524.2 recommends the use of either a VOCOL wide-bore or a narrow-bore capillary column to separate constituents. These constituents are detected with a mass spectrometer. Precision and accuracy of this method is similar to Method 524.1. The single laboratory accuracy and precision were determined for various VOCs by analyzing replicate samples of reagent water spiked at levels from 0.1 to 10 µg/l. The accuracy expressed as average percent recovery ranged from 83 to 109 percent and the precision expressed as relative standard deviations ranged from 3.9 to 19.9 percent.

b. *Pesticides.* The EPA developed six analytical methods for pesticides. Two of the methods can be used to screen for the presence of polychlorinated biphenyls (PCBs). (See also the discussion of PCBs analysis below.) EPA proposes using these methods, as listed below, to analyze for pesticides and to screen for PCBs.

(1) U.S. EPA Method 504, "1,2-Dibromoethane (EDB) and 1,2-Dibromo-3-chloropropane (DBCP) in Water by Microextraction and Gas Chromatography", 1986. Contaminants Analyzed: Dibromochloropropane, Ethylene Dibromide.

(2) U.S. EPA Method 505, "Analysis of Organohalide Pesticides and Aroclors in Drinking Water by Microextraction and Gas Chromatography", 1986. Contaminants Analyzed: Alachlor, Atrazine, Chlordane, Heptachlor, Heptachlor Epoxide, Lindane, Methoxychlor, and Toxaphene.

(3) U.S. EPA Method 507, "Determination of Nitrogen- and Phosphorus-Containing Pesticides in Ground Water by Gas Chromatography with a Nitrogen-Phosphorus Detector", 1987. Contaminants Analyzed: Alachlor and Atrazine.

(4) U.S. EPA Method 508, "Determination of Chlorinated Pesticides in Ground Water by Gas Chromatography with an Electron Capture Detector", 1987. Contaminants Analyzed: Chlordane, Heptachlor, Heptachlor Epoxide, Lindane, and Methoxychlor.

(5) U.S. EPA Method 515.1, "Determination of Chlorinated Acids in Ground Water by Gas Chromatography

with an Electron Capture Detector", 1987. Contaminants Analyzed: 2,4-D, 2,4,5-TP (Silvex), entachlorophenol.

(6) U.S. EPA Method 531.1, "Measurement of N-Methyl Carbamoyloximes and N-Methyl Carbamates in Ground Water by Direct Aqueous Injection HPLC with Post Column Derivatization", 1987. Contaminants Analyzed: Aldicarb, Aldicarb Sulfoxide, Aldicarb Sulfone, Carbofuran.

The sampling procedures for SOC are specified in each method. Because of their volatility, EDB and DBCP samples are collected headspace-free. With the exception of Method 531.1, which uses direct injection of a filtered water sample, all of the SOC methods use a solvent extraction procedure to extract the analyte(s). This may be followed by derivatization or cleanup steps prior to chromatographic analysis. The constituents are then separated in a chromatographic column and measured with a specific detection system.

Method 504 measures volatile pesticides EDB and DBCP. Although these compounds may be analyzed using purge-and-trap methods, the sensitivity is improved using a liquid-liquid extraction and an electron capture detector. The method recommends the use of a narrow-bore fused silica, GC capillary column for constituent separation. The single laboratory accuracy and precision were determined by analyzing replicate tap water samples spiked at levels from 0.030 µg/l to 50 µg/l. The results show accuracy, expressed as percent average recoveries, ranged from 90 to 114 percent, and precision, expressed as percent relative standard deviation, ranged from 4.7 to 11.8 percent for these compounds.

Method 505 measures alachlor, atrazine, chlordane, heptachlor, heptachlor epoxide, lindane, methoxychlor, toxaphene and screens for PCBs. This method uses the same liquid-liquid extraction procedure as Method 504. Similarly, separation, identification, and measurement are by capillary column GC with an electron capture detector. The single laboratory accuracy and precision was determined by analysis of replicate samples of reagent, ground, and tap water matrices spiked generally at low µg/l to submicrogram/l levels. With the exception of the very low levels for heptachlor, accuracy generally ranged from about 80 to 120 percent and precision generally ranged from about 3 to 20 percent for the method analytes.

Method 507 measures certain nitrogen- and phosphorus-containing



pesticides, including alachlor and atrazine. Method 508 measures chlordane, heptachlor, heptachlor epoxide, lindane and methoxychlor. The methods are identical, except for the detection system. Both methods use a liquid-liquid extraction procedure, separation with a fused silica GC capillary column. For Method 507 detection is by nitrogen-phosphorus (NPD); for Method 508 detection is by electron capture detector. Method 507 reported a 119 percent recovery and 10 percent relative standard deviation for alachlor. Method 508 recoveries ranged from 67 to 120 percent and relative standard deviations ranged from 3 to 18 percent for the five proposed analytes.

Since Methods 507 and 508 were developed to analyze a large number of pesticides, States or utilities that want to monitor for more pesticides than are covered in Method 505 may want to use these methods. Otherwise, Method 505 is preferable to Methods 507 and 508 because it covers the same analytes and it is cheaper and easier to use.

Method 515.1 measures 2,4-D, 2,4,5-TP (Silvex) and pentachlorophenol (as well as other chlorinated acid herbicides). This method uses liquid-liquid extraction with ether and either a packed column or capillary column for constituent separation. These constituents are then measured with an electron capture detector. The single laboratory accuracy and precision was determined by analyzing replicate samples of reagent water and/or drinking water. The results indicated average recoveries ranged from 63 percent to 88 percent and relative standard deviations ranged from 4 percent to 13 percent for the three pesticides. Method 515.1 is similar to Method 515 and measures the same contaminants. However, Method 515.1 includes a clean-up procedure and uses only capillary columns for the separation of the constituents.

Method 531.1 measures aldicarb, aldicarb sulfoxide, aldicarb sulfone, and carbofuran. Unlike the other methods described above, this is a high pressure liquid chromatography (HPLC) method instead of a GC method. The water sample is filtered and a 400  $\mu$ l aliquot is injected into a reverse phase HPLC column which separates the components. After elution from the column, the analytes are hydrolyzed and reacted with o-phthalaldehyde to form a highly fluorescent compound. This compound is then detected with a fluorescence detector. Single laboratory precision and accuracy was determined in reagent water using spikes of 2 to 3  $\mu$ g/l. The recoveries ranged from 88 to

112 percent and the relative standard deviations ranged from 6 to 21 percent.

The analytical methods described above for analyzing the pesticides listed in this proposal were developed recently. However, most of these methods use gas chromatography (GC) instrumentation which is available in most analytical laboratories. Methods 531 and 531.1 utilize high pressure liquid chromatography (HPLC). This instrumentation is not as widely available as GC, but it is common in many of the larger analytical laboratories. The analytical costs of the GC and HPLC methods are estimated at \$200 or less per sample analyzed.

All available methods require second column confirmation of any positives. Although there are no GC/MS methods presently available, EPA is investigating GC/MS methods for those analytes which use gas chromatography. EPA will evaluate GC/MS methods for compliance monitoring as they become available.

**c. Polychlorinated Biphenyls (PCBs).** Polychlorinated biphenyls (PCBs) are a class of compounds which have widely varying physical and chemical properties. These compounds have very low solubility in water and tend to be adsorbed to suspended matter in natural water. The tendency for adsorption increases with the degree of chlorination and with the organic content of the adsorbent. The persistency of PCBs in the environment increases with the degree of chlorination.

Aroclors are technical mixtures of a number of individual PCBs made by the partial chlorination of biphenyl. Two hundred and nine possible compounds can result from the partial or total chlorination of biphenyl and around 100 individual compounds have been detected in various Aroclor mixtures. Individual Aroclor mixtures are designated by a set of four digits.

The analysis of PCBs in environmental samples is complex because of the large number of compounds involved. Most available PCB analytical methods are adaptations of chlorinated pesticides procedures. The most common approach is to determine PCBs as Aroclors because of the complexity of interpreting the raw data (chromatograms) and because of the lack of other standards. In Methods 505 and 508, PCBs can be determined as Aroclors. This procedure is at best approximate when the sample resembles one of the Aroclor standards. The identification of PCBs, measured as Aroclors, in finished drinking water is particularly difficult because the treatment processes (e.g., coagulation,

sedimentation) remove specific PCBs at different rates and the sample is not likely to match any of the Aroclor standards. Hence quantitation in drinking water samples using Methods 505 and 508 is not realistic. However, because these methods are quite sensitive, they can be used as a qualitative screen for PCBs.

EPA has investigated other approaches to determine PCBs in drinking water that do not involve Aroclor pattern recognition. One approach is based on the exhaustive chlorination (i.e., perchlorination) of the biphenyl ring of the PCB compounds to form decachlorobiphenyl. Perchlorination methods have been studied for many years because it is relatively simple to determine one component, decachlorobiphenyl, instead of a complex mixture. In general, these perchlorination methods have been used for screening samples for PCBs, but not for quantitative purposes because the precision of this technique has been poor.

Recently, EPA adapted a procedure that appears to provide very good precision at the concentration level of concern (i.e., 0.0005 mg/l). Method 508A, "Total Polychlorinated Biphenyls by Perchlorination/Gas Chromatography," extracts a one-liter sample followed by conversion of PCBs to decachlorobiphenyl. Antimony pentachloride is used in the perchlorination step. A capillary column and an electron-capture detector are used in the gas chromatographic measurement. This method is relatively simple and sensitive. Recoveries in tap water spiked at 0.0005 mg/l each of biphenyl and six Aroclors averaged 110 percent with a relative standard deviation of 8 percent. A problem with this procedure is that biphenyl and other non-PCB contaminants may produce false positives.

EPA is proposing the following approach to analyze PCBs. Methods 505 or 508 will be used to screen samples for PCBs. Methods 505 and 508 utilizing capillary columns can separate PCB isomers from other contaminants. These methods can detect environmentally degraded PCBs with some certainty. Samples with detectable PCBs (that is peaks within retention time windows for PCB isomers) must be reanalyzed using Method 508A to quantitate PCBs.

EPA believes that the problem of quantitation using Methods 505 and 508 and the problem of interferences with Method 508A are addressed by using the three methods in tandem as described above. The procedure EPA has proposed minimizes the false positive problem



because most samples with interfering substances will be screened out using Methods 505 or 508. Those samples having PCBs present can be quantified using method 508A. EPA believes that it is reasonable and conservative to determine compliance based upon the quantitative result of Method 508A. EPA requests comments on the protocol to screen and quantitate PCBs.

EPA is proposing the use of the three methods, as listed below, for the compliance monitoring requirement for PCBs.

(1) U.S. EPA Method 505, "Analysis of Organohalide Pesticides and Aroclors in Drinking Water by Microextraction and Gas Chromatography," 1986.

(2) Method 508, "Determination of Chlorinated Pesticides in Ground Water by Gas Chromatography with an Electron Capture Detector," 1987.

(3) Method 508A, "Total Polychlorinated Biphenyls (PCBs) by Perchlorination/Gas Chromatography." Method 508A is used to quantitate PCBs (as decachlorobiphenyl).

Public comments are requested on the proposed approach to measure PCBs in drinking water and on the proposed analytical methods.

### 3. Method Detection Limits and Practical Quantitation Levels

Generally, EPA defines the method detection limit (MDL) as the minimum concentration of a substance that can be measured and reported with 99 percent confidence that the true value is greater than zero. The practical quantitation level (PQL) is the lowest concentration that can be reliably measured within specified limits of precision and accuracy during routine laboratory operating conditions. Differences between the MDLs and PQLs are expected, and the PQL is generally about five to ten times the MDL for relatively clean matrices such as finished drinking water. (See 52 FR 25699 (July 8, 1987) and 50 FR 46906 (November 13, 1985) for a detailed discussion on MDLs and PQLs.)

The PQL is determined through interlaboratory studies, such as performance evaluation (PE) studies. However, if data are not available from interlaboratory studies, the PQLs are estimated by setting the PQL at a higher concentration than the MDL. In such cases, EPA believes that a PQL set at ten times the MDL achieved by good laboratories is generally a fair expectation during routine operation of most qualified State and commercial laboratories. The use of "five times the MDL" instead of "ten times the MDL" to set the PQL may be recommended when other considerations suggest that the

PQL should be lower (e.g., see discussion on the PQL for vinyl chloride at 52 FR 25700, July 8, 1987).

As noted previously, EPA evaluates the PQL as part of its determination of what level is as close to the MCLG as feasible. Consideration of the PQL is especially important for those contaminants for which EPA is proposing MCLGs at zero. Since the "zero level" cannot be measured, EPA evaluates the performance of available analytical techniques to ascertain which level greater than zero can be measured within acceptable limits of precision and accuracy. Therefore, for the carcinogenic contaminants, the proposed MCLs are all equal to or greater than their PQLs.

a. *Inorganics.* EPA has estimated MDLs and PQLs for the proposed analytical techniques. These are summarized in Tables 8 and 10. The following discussion summarizes the derivation of the MDLs and PQLs for the IOCs. It should be noted, however, that the PQLs for these contaminants are all lower than their MCLGs. Therefore, the PQL in these cases are not a limiting factor in deriving the proposed MCLs.

Detection limits for IOCs are traditionally based on a concentration that corresponds to a specified instrument signal to noise ratio (i.e., peak height to background). Most detection limits given in Table 8 are estimated in this manner. The detection limits for Inductively Coupled Plasma (ICP) using the concentration technique (the numbers in parentheses in Table 8) were calculated based upon a different approach known as method detection limit (MDL). The MDL approach involves the determination of detection limits using a procedure defined in Appendix B to 40 CFR Part 136. EPA is using the MDL procedure outlined in Appendix B to calculate limits of detection for analytes in all newly developed methods.

The PQLs for inorganics are determined based primarily upon the MDLs and the results from performance evaluation (PE) studies. Nitrite and asbestos are exceptions. No PE data is available for these two contaminants. EPA estimates the nitrite PQL is the same as the PQL for nitrate because the same methods are used and analyses are conducted in a similar manner. Also the detection limits for these two contaminants are similar (see Table 8). The PQL for asbestos is estimated to be ten times the MDL or 0.1 million fibers per liter. The PQLs for nitrite and asbestos will be verified in future studies.

The PQLs for the remaining inorganics (barium, cadmium, chromium, mercury,

nitrate, and selenium) are determined using EPA and State laboratory data from Water Supply (WS) PE studies #12-17. These results are considered to be optimum since they are drawn from experienced laboratories operating under conditions where they knew they were being tested with standard samples in distilled water without interferences. Actual day to day operations in a wide variety of laboratories using "real" samples in natural water would be expected to produce less accurate results with wider performance ranges especially at lower concentrations.

The following procedure has been used to determine the PQLs for inorganic contaminants (except nitrite and asbestos) using the PE study data:

1. Regression equations were generated for precision and accuracy using the EPA and State laboratory data for each inorganic contaminant except nitrate. The regression equations for nitrate were generated using the data from all laboratories because EPA and State laboratories tend to use automated methods which produce more stringent acceptance limits.

2. The percent recovery and relative standard deviation were calculated at the proposed MCLs using the regression equations generated from the data for each of the inorganics. The percent recovery and relative standard deviation were used to estimate the 95 percent confidence limits. The percent recovery, relative standard deviation, and the 95 percent confidence limits for the six inorganics are summarized in Table 9.

3. EPA and State laboratory data for the six inorganics were evaluated to determine the range as a percent of the true value. This range most closely approximates the 95 percent confidence limits estimated from the regression equations. The range of the true value is summarized in Table 9.

4. The PQLs were set at a concentration where at least 75 percent of EPA and State laboratories are within the specified acceptance range. The PQLs for the six inorganics are summarized in Table 10.

The following example illustrates this procedure. The regression equations for chromium based on the data from WS studies #12-17 are:

$$X = 0.996T + 0.203$$

$$S = 0.0635T + 0.501$$

where X is the mean recovery, T is the true concentration, and S is the standard deviation. The proposed MCLG for chromium is 0.1 mg/l. The regression equations are solved using 0.1 mg/l as the true concentration. The calculated



mean recovery is divided by the true concentration and multiplied by 100 to obtain the percent recovery. The calculated standard deviation is divided by the true concentration and multiplied by 100 to obtain the relative standard deviation. The percent recovery is 100 percent and the relative standard deviation is 7 percent when the MCLG for chromium is set at 0.1 mg/l. The 95 percent confidence limits are estimated as  $100 \pm 2(7)$  percent [percent recovery  $\pm (2)$  (relative standard deviation)] or 86 to 114 percent of the "true" value. Thus,  $\pm 15$  percent of the "true" value most closely approximated the 95 percent confidence limits. The PQL is then determined from the WS studies #12-17 data for  $\pm 15$  percent of the "true" value. These data are summarized in Table 11.

The data in Table 11 demonstrate that the percentage of laboratories within  $\pm$

15 percent of the "true" value remained fairly constant over the concentration range except for the first concentration. The concentrations in Water Supply studies #12-17 ranged from 11 to 132  $\mu\text{g/l}$ . The data at the lowest concentration (5.10  $\mu\text{g/l}$ ) was obtained from Water Pollution study #11. The percentage of laboratories within  $\pm 15$  percent of the "true" value is considerably lower at 5.10  $\mu\text{g/l}$  than at any of the other concentrations. The lower percentage at 5.10  $\mu\text{g/l}$  is due to two factors. The first is that different laboratories participated in the Water Pollution and Water Supply studies. The second is that laboratory performance was less accurate as the analyte concentration decreased. Decreasing the concentration resulted in a percentage decrease of laboratories within  $\pm 15$  percent of the "true" concentration. For concentrations greater than 5.10  $\mu\text{g/l}$ ,

the percentage of laboratories within 15 percent of the "true" value remained fairly constant. It is greater than 75 percent at all concentrations greater than 5.10  $\mu\text{g/l}$ . Because PQLs are set at a concentration where at least 75 percent of EPA and State laboratories are within the specified acceptance range, the PQL for chromium was assumed to be between 5.10  $\mu\text{g/l}$  and 11.0  $\mu\text{g/l}$ . For chromium, with an MCLG of 0.1 mg/l, the PQL was set at 0.01 mg/l. The PQL was set at the higher end of the acceptance range so that greater precision can be required. For more information on how the PQLs for inorganic contaminants were determined, see the *Methods and Monitoring Document for IOCs*. Public comments are requested on the approach used to determine the PQLs for inorganic contaminants and on the proposed PQLs for these contaminants.

TABLE 8. DETECTION LIMITS FOR AVAILABLE ANALYTICAL METHODS

Contaminant	Proposed MCL (mg/l)		Detection limit (mg/l) <sup>2</sup>
Asbestos.....	7 MFL.....	Transmission Electron Microscopy.....	0.01 MFL
Barium.....	5.....	Atomic Absorption; furnace technique.....	0.002
		Atomic Absorption; direct aspiration.....	0.1
		Inductively Coupled Plasma.....	<sup>1</sup> 0.002(0.001)
Cadmium.....	0.005.....	Atomic Absorption; furnace technique.....	0.0001
		Inductively Coupled Plasma.....	<sup>1</sup> 0.001
Chromium.....	0.1.....	Atomic Absorption; furnace technique.....	0.001
		Inductively Coupled Plasma.....	<sup>1</sup> 0.007(0.001)
Mercury.....	0.002.....	Manual Cold Vapor Technique.....	0.0002
		Automated Cold Vapor Technique.....	0.0002
Nitrate.....	10 (as N).....	Manual Cadmium Reduction.....	0.01
		Automated Hydrazine Reduction.....	0.01
		Automated Cadmium Reduction.....	0.05
		Ion Selective Electrode.....	1
		Ion Chromatography.....	0.01
Nitrite.....	1 (as N).....	Spectrophotometric.....	0.01
		Automated Cadmium Reduction.....	0.05
		Manual Cadmium Reduction.....	0.01
		Ion Chromatography.....	0.004
Selenium.....	0.05.....	Atomic Absorption; furnace.....	0.002
		Atomic Absorption; gaseous hydride.....	0.002

<sup>1</sup> Using concentration technique in Appendix A to EPA Method 200.7.

<sup>2</sup> See text.

TABLE 9. 95 PERCENT CONFIDENCE LIMITS FOR INORGANICS

Inorganic contaminant	MCLG (mg/l)	Percent recovery	Relative standard deviation	95 Percent confidence limits (percent of true value)
Barium.....	5	97	5	87-107
Cadmium.....	0.005	93	10	73-113
Chromium.....	0.1	100	7	86-114
Mercury.....	0.002	99	14	71-127
Nitrate.....	10	100	6	88-112
Selenium.....	0.05	97	12	73-121



TABLE 10. INORGANIC ACCEPTANCE LIMITS AND PQLs

Inorganic contaminant	MCLG (mg/l)	Acceptance limits (plus or minus percent of the true value)	PQLs (mg/l)
Barium.....	5	15	0.15
Cadmium.....	0.005	20	0.002
Chromium.....	0.1	15	0.01
Mercury.....	0.002	30	0.0005
Nitrate.....	10	10	0.4
Nitrite <sup>1</sup> .....	1	10	0.4
Selenium.....	0.05	20	0.01

<sup>1</sup> Nitrite is assumed to have the same acceptance limits and PQL as nitrate because the same methods are used to analyze samples for both inorganics and the analyses are conducted in a similar manner.

TABLE 11.—EPA AND STATE LABORATORY DATA FOR CHROMIUM

T.V. (μg/l)	No. of labs	Percentage of labs within ±15 percent T.V.
5.10 <sup>1</sup> .....	44	55
11.0.....	64	77
14.3.....	62	81
16.5.....	46	83
28.6.....	47	85
30.8.....	41	83
35.7.....	62	89
44.1.....	41	83
64.3.....	62	90
78.6.....	63	94
92.9.....	47	91
110.....	64	89
132.....	46	87

T.V. = "true" value or reference concentration.  
Note: Data obtained from Water Supply Studies #12-17.

<sup>1</sup> Data at this concentration are obtained from Water Pollution study #11.

b. *Synthetic Organic Chemicals.* This proposal contains EPA estimates of MDLs and PQLs for the volatile organic compounds (VOCs), pesticides, and polychlorinated biphenyls (PCBs). The VOCs, pesticides, and PCBs are discussed separately below because the approach to estimate MDLs and PQLs for each is different. The different approaches result from the type and amount of available performance data.

The VOCs were included in Water Supply performance studies. In addition, other VOC performance data are also available. EPA has evaluated these available data to estimate the VOC MDLs.

The analytical methods for pesticides were only developed recently and consequently were not included in the Water Supply studies. The analytical method to quantitate PCBs was recently adapted to measure PCBs as decachlorobiphenyl. EPA conducted a special interlaboratory study to estimate MDLs and PQLs for the pesticide/analytes. The following discussion summarizes the derivation of the MDLs and PQLs for the VOCs, pesticides, and PCBs.

*Volatile organic compounds (VOCs)*—A survey of seven U.S. EPA laboratories and EPA contract laboratories reported MDL averages ranging from 0.0002 to 0.0005 mg/l for the ten proposed VOCs. The MDL range of 0.0002 to 0.0005 mg/l is the result of measurements made by a

few experienced laboratories under non-routine and very controlled conditions. These levels are not expected to be representative of the capabilities of a cross-section of good laboratories performing compliance VOC measurements on a routine basis.

The PQLs for the proposed VOCs were primarily based upon the results of MDL surveys of EPA and non-EPA laboratories and from the Water Supply performance evaluation studies. EPA considered the PQLs to determine the proposed VOC maximum contaminant levels. As noted previously, the PQLs are critical to determine the MCLs for carcinogenic contaminants with MCLGs of zero.

Table 12 summarizes recent Water Supply (WS) performance evaluation data from EPA and State laboratories (WS Study #17 for tetrachloroethylene data and WS Study #18 for all other listed VOCs). The performance evaluation studies establish acceptance limits between ±20 percent and ±40 percent of the reference "true" value for VOC concentrations between 1 and 10 μg/l. The data from WS Studies #17 and 18 show that approximately 74 percent of all performance samples analyzed were within ±20 percent of the true value and about 95 percent within ±40 percent of the true value. These results are similar to the results achieved by EPA and State laboratories for the eight VOCs promulgated in July, 1987. (See 52 FR 25690, July 8, 1987).

TABLE 12.—PERFORMANCE OF EPA AND STATE LABORATORIES ANALYZING VOCs IN WATER SUPPLY PERFORMANCE EVALUATION STUDIES

Compound	T.V. (μg/l)	No. of labs	No. (and percent) labs within ±20 percent T.V. <sup>1</sup>	No. (and percent) labs within ±40 percent T.V. <sup>1</sup>
cis-1,2-Dichloroethylene.....	4.62	31	19 (61)	27 (87)
trans-1,2-Dichloroethylene.....	0.81	34	18 (53)	25 (74)
Chlorobenzene.....	1.33	42	24 (57)	36 (86)
o-Dichlorobenzene.....	8.58	42	31 (74)	41 (98)
	1.77	32	22 (69)	29 (91)
	7.58	35	28 (80)	31 (89)
1,2-Dichloropropane.....	1.06	36	20 (56)	27 (75)
	6.39	42	30 (71)	38 (90)
Ethylbenzene.....	1.26	40	27 (68)	35 (88)
	6.29	42	30 (71)	39 (93)
Styrene.....	2.43	29	22 (76)	25 (86)
	12.2	30	23 (77)	27 (90)
Tetrachloroethylene.....	2.18	37	27 (73)	35 (95)
	8.74	38	34 (89)	37 (97)
Toluene.....	1.66	41	29 (71)	38 (93)
	11.6	42	37 (88)	41 (98)
Xylene-O.....	2.26	19	15 (79)	19 (100)
	9.70	19	14 (74)	18 (95)

<sup>1</sup> T.V. = "True Value".

The studies indicate that the number of laboratories producing data outside the acceptance limits generally

increases as the analyte concentration decreases. At concentrations less than 5 μg/l, 53 percent to 79 percent of the

laboratories were within ±20 percent of the true value for each VOC tested. At concentrations greater than 5 μg/l, 71



percent to 89 percent of the laboratories were within  $\pm 20$  percent of the true value for each VOC tested. If the  $\pm 40$  percent acceptance limits are used, a similar trend indicating more laboratories able to perform within the limits exists. Because experienced laboratories operated under conditions where they knew they were being tested with standard samples, these results are considered optimum. EPA expects that the actual percentage of private

commercial laboratories able to meet the specified performance limits will likely be lower.

EPA summarized the results from other non-EPA/State laboratories participating in performance evaluation studies. Table 13 indicates that about 62 percent of the laboratories are within  $\pm 20$  percent of the true value and about 82 percent of the laboratories are within  $\pm 40$  percent of the true value. (This compares with 74 percent and 95

percent of the EPA/State laboratories for the  $\pm 20$  percent and  $\pm 40$  percent acceptance limits, respectively.) Forty percent to 65 percent of non-EPA/State laboratories were within  $\pm 20$  percent of the true value at concentrations below 5  $\mu\text{g/l}$  for individual analytes whereas 60 percent to 74 percent were within  $\pm 20$  percent of the true value at concentrations greater than 5  $\mu\text{g/l}$ .

TABLE 13.—PERFORMANCE OF NON-EPA AND NON-STATE LABORATORIES ANALYZING VOCs IN WATER SUPPLY

## Performance Evaluation Studies

Compound	T.V. ( $\mu\text{g/l}$ )	No. of labs	No. (and percent) labs within $\pm 20$ percent T.V. <sup>1</sup>	No. (and percent) labs within $\pm 40$ percent T.V. <sup>1</sup>
cis-1,2-Dichloroethylene.....	4.62	120	77 (64)	99 (83)
trans-1,2-Dichloroethylene.....	0.81	116	46 (40)	77 (66)
Chlorobenzene.....	1.33	126	80 (63)	103 (82)
	8.58	132	98 (74)	116 (88)
o-Dichlorobenzene.....	1.77	118	59 (50)	91 (77)
	7.58	124	74 (60)	95 (77)
1,2-Dichloropropane.....	1.06	123	72 (58)	95 (77)
	6.39	132	93 (70)	113 (86)
Ethylbenzene.....	1.26	128	76 (59)	107 (84)
	6.29	131	90 (69)	113 (86)
Styrene.....	2.43	112	73 (65)	97 (87)
	12.2	116	84 (72)	99 (85)
Tetrachloroethylene.....	2.18	109	55 (50)	81 (74)
	8.74	108	77 (72)	100 (93)
Toluene.....	1.66	132	71 (54)	102 (77)
	11.6	133	99 (74)	116 (87)
o-Xylene.....	2.26	87	51 (59)	71 (82)
	9.70	88	59 (67)	78 (89)

<sup>1</sup> T.V. = "True Value."

Based on the available data (i.e., interlaboratory method detection limits, and Water Supply performance evaluation study data), EPA estimated PQLs of 0.005 mg/l (or 5  $\mu\text{g/l}$ ) for the proposed VOCs. These PQLs are consistent with the study results. Most laboratories appear to perform acceptably at concentrations of 5  $\mu\text{g/l}$  or above. Although many laboratories are able to perform acceptably at concentrations below 5  $\mu\text{g/l}$ , the number of laboratories achieving acceptable performance decreases at lower concentrations. Consequently, laboratories may not be able to achieve performance within the acceptance range for all VOCs consistently. Although the laboratory approval requirements consider that laboratories will occasionally fall outside the acceptance limits established for individual VOC analytes, the PQLs selected for this proposal are set at a level where adequate performance is expected for most laboratories.

The VOC PQLs as calculated by EPA are approximately ten times the MDLs for these contaminants. EPA believes that the results of these studies and

subsequent analyses confirm that PQLs can be approximated on the basis of MDLs. (See 50 FR 46906, November 13, 1985.) While the estimation approach is not ideal and it is preferable to rely on actual laboratory data, the VOCs study results indicate that PQLs of ten times the MDL are acceptable estimates.

Public comments are requested on the approach used for the determination of PQLs and the PQLs for the proposed VOCs.

**Pesticides and PCBs**—The proposed analytical methods to determine pesticide concentrations and to screen for PCBs were developed recently. Therefore, these methods were not included in previous performance evaluation studies. Information currently available to EPA to estimate a PQL consists of: (1) The single laboratory calculated MDLs using the procedure described in 40 CFR part 136, Appendix B, and (2) interlaboratory MDLs based on a study conducted by EPA's Environmental Monitoring and Support Laboratory (EMSL) in Cincinnati.

The interlaboratory MDL study verified the single laboratory MDLs for

eighteen analytes using four proposed methods: 504, 505, 515 and 531. These methods were included in this study because they cover the proposed pesticides (atrazine was the only pesticide not included in the interlaboratory MDL study). Seven laboratories participated in this study—three EPA laboratories and four contract laboratories. Five laboratories used Methods 504 and 505 and three laboratories used Methods 515 and 531. The limited number of laboratories evaluating Methods 515 and 531 resulted from a lack of equipment.

The process for calculating interlaboratory MDLs (IMDLs) was as follows: MDLs were determined for each method and analytes using local finished drinking water. Each laboratory "estimated" the detection limit by determining the concentration value for each analyte that corresponded to an instrument signal to noise ratio (i.e., peak height to background). This ratio ranged from 2.5 to 5.0. For each method, each laboratory ran two replicate analyses, one reagent blank and one quality control (QC) sample, through the entire analytical procedure on each of



four days. The precision within each laboratory was estimated from the eight replicates. These estimates were pooled to obtain an average within-laboratory precision estimate. The within laboratory estimate was subsequently used to calculate the IMDL. This IMDL serves as the MDL for an average laboratory.

Table 14 summarizes the single laboratory MDLs and the interlaboratory MDLs (IMDLs) for pesticides and the single laboratory MDL using Method 508A for PCBs. In most cases, the interlaboratory MDLs are similar or somewhat higher than the single laboratory MDLs. Exceptions were methoxychlor and 2,4,5-TP (silvex). The IMDL for these two SOCs was approximately one-tenth the single laboratory MDL. A possible explanation is that the single laboratory MDL for both SOCs was calculated using a sample spiked at a concentration that was high, relative to the detection limit. EPA has observed that if a laboratory uses a concentration many times higher than the detection limit, the calculated MDL value may be deceptively high.

Because performance evaluation data are not available, the PQLs for the pesticide contaminants in this proposal are estimated as ten times the interlaboratory MDLs. (Synthetic Organic Chemicals, Methods and Monitoring Document, 1987.) This approach to determining PQLs when data is not available is supported by previous studies which indicate that PQLs are generally ten times the MDL. The IMDL was selected instead of the single laboratory MDL because the IMDL provides a more realistic expectation of the detection limits achievable by a group of laboratories. The single laboratory MDL for atrazine was used to determine the PQL because atrazine was not included in the interlaboratory study. EPA expects that qualified laboratories should reliably analyze concentrations ten times the method detection limit concentrations. EPA will verify actual laboratory performance at the PQL level in future multilaboratory validation studies and performance evaluation studies.

TABLE 14. INTERLABORATORY METHOD DETECTION LIMITS (IMDLs) AND SINGLE LABORATORY METHOD DETECTION LIMITS (MDLs) REPORTED IN THE ANALYTICAL METHODS<sup>1</sup>

	IMDL (mg/l)	MDL (mg/l)
A. Method 505:		
(a) Chlordane .....	0.00018	0.00014

TABLE 14. INTERLABORATORY METHOD DETECTION LIMITS (IMDLs) AND SINGLE LABORATORY METHOD DETECTION LIMITS (MDLs) REPORTED IN THE ANALYTICAL METHODS<sup>1</sup>—Continued

	IMDL (mg/l)	MDL (mg/l)
(b) Toxaphene .....	0.00108	0.0010
(c) PCBs:		
Aroclor 1016 .....		0.00008
Aroclor 1221 .....		0.015
Aroclor 1232 .....		0.00048
Aroclor 1242 .....		0.00031
Aroclor 1248 .....		0.000102
Aroclor 1254 .....		0.000102
Aroclor 1260 .....		0.000189
(e) Lindane .....	0.00002	0.000003
(f) Alachlor .....	0.00015	0.00023
(g) Heptachlor .....	0.00004	0.000003
(h) Heptachlor Epoxide .....	0.00002	0.000004
(i) Methoxychlor .....	0.00011	0.00096
B. Method 504:		
(a) Ethylene Dibromide (EDB) .....	0.00001	0.00001
(b) Dibromochloropropane (DBCP) .....	0.00002	0.00001
C. Method 515:		
(a) 2,4-D .....	0.0001	0.00001
(b) 2,4,5-TP (Silvex) .....	0.00002	0.00017
(c) Pentachlorophenol .....	0.00001	0.0000005
D. Method 531:		
(a) Aldicarb .....	0.0005	0.00013
(b) Aldicarb Sulfoxide .....	0.0008	0.0008
(c) Aldicarb Sulfone .....	0.0003	0.0005
(d) Carbofuran .....	0.0007	0.0009
E. Method 508A:		
(a) PCBs (as Decachlorobiphenyl) <sup>2</sup> .....		
Aroclor 1016 .....		0.0004
Aroclor 1221 .....		0.00036
Aroclor 1232 .....		0.00050
Aroclor 1242 .....		0.00040
Aroclor 1248 .....		0.00021
Aroclor 1254 .....		0.00021
Aroclor 1260 .....		0.00021

<sup>1</sup> Atrazine was not included in the study for determination of IMDLs. The MDL estimated single laboratory MDL for atrazine is 0.0001 mg/l.

<sup>2</sup> Note: PCB MDLs are calculated as the amount of decachlorobiphenyl produced at the MDL for individual Aroclors.

For EDB and toxaphene, EPA set the PQL at five times the IMDL. Lower contaminant levels are associated with greater difficulty in measurement and consequently less precision and accuracy of applicable analytical methods. However, EPA believes that it is appropriate to accept slightly less precision in measurement if the risk posed by a carcinogenic contaminant is greater than the  $10^{-4}$  to  $10^{-6}$  risk range generally considered by the Agency to be acceptable. For EDB, a level of 0.0001 mg/l (10 times the IMDL) is associated with an increased cancer risk of  $3 \times 10^{-4}$ . For toxaphene, a level of 0.001 (10 times the IMDL) is associated with an increased cancer risk of  $3 \times 10^{-4}$ . Levels of 0.00005 mg/l and 0.005 mg/l (5 times the IMDL) for EDB and toxaphene, respectively, would be associated with lower risks levels approximately equal

to  $10^{-4}$ . EPA recognizes that, at these levels, slightly less precision and accuracy will occur. However, EPA believes that it is appropriate to accept slightly less precision in order to obtain more stringent levels of control. The revised PQLs are consistent with the Agency's policy of regulating carcinogens, within a risk range of  $10^{-4}$  to  $10^{-6}$ . Public comments are requested on this approach.

A concentration level of 0.0005 mg/l of decachlorobiphenyl represents concentrations of 0.0002 to 0.0004 mg/l of the intact Aroclors. Therefore, setting the MCL at 0.0005 mg/l (measured as the decachlorobiphenyl) is within the  $10^{-4}$  to  $10^{-6}$  risk level that the Agency considers protective of public health.

A precise MDL for PCBs (as decachlorobiphenyl) is difficult to calculate, as can be seen from Table 14. The PCB MDL's shown in Table 14 correspond to decachlorobiphenyl levels of 0.2 to 0.0005 mg/l. EPA believes that the MDL for the individual Aroclors determined by perchlorination may be as low as 0.0001 mg/l. A single laboratory validation study using Method 508A was conducted and indicated a linear response with good precision from 0.00005 to 0.005 mg/l when calibration standards were run. The Agency will evaluate performance evaluation study data after this rule is proposed to provide more complete information on the MDLs for the PCBs.

TABLE 15.—PQLs FOR PESTICIDES AND PCBs

Compound	PQL (mg/l)
Aldicarb .....	0.005
Aldicarb Sulfone .....	0.003
Aldicarb Sulfoxide .....	0.008
Atrazine .....	<sup>1</sup> 0.001
Alachlor .....	0.002
Carbofuran .....	0.007
Chlordane .....	0.002
2,4-D .....	0.001
Dibromochloropropane (DBCP) .....	0.0002
Ethylene Dibromide (EDB) .....	0.00005
Heptachlor .....	0.0004
Heptachlor Epoxide .....	0.0002
Lindane .....	0.0002
Methoxychlor .....	0.001
PCBs (as decachlorobiphenyl) .....	<sup>2</sup> 0.0005
Pentachlorophenol .....	0.0001
Toxaphene .....	0.005
2,4,5-TP (Silvex) .....	0.0002

<sup>1</sup> PQL is 10 times the MDL specified in Method 507.

<sup>2</sup> EPA is estimating that the PQL for PCBs (as decachlorobiphenyl) is 0.0005  $\mu$ g/l. This level is associated with an increased cancer risk of up to  $10^{-4}$ .

Public comments are requested on the PQLs for these contaminants and any additional performance data available.



### B. Treatment Technologies, Costs, and Selection of the Proposed MCLs

Section 1412(b)(6) of the Act states that each national primary drinking water regulation which establishes an MCL shall list the technology, treatment techniques, and other means which the Administrator finds to be feasible for meeting the MCL. However, a regulation shall not require the use of any of the technologies, treatment techniques, or other means specified for the purpose of meeting an MCL.

In order to fulfill the requirements of section 1412(b)(6), EPA has identified the best available technologies (BAT) for each chemical listed in this proposal. BAT is determined by identifying available technologies which reduce contaminant concentration levels and by evaluating the costs and commercial availability of the technologies. As noted above, technologies are BAT based upon the following factors: high removal efficiency, general geographic applicability, compatibility with other water treatment processes, and the ability to achieve compliance at a reasonable cost. The criterion used in

determination of whether such technologies are feasible is whether they are reasonably affordable by regional and large metropolitan public water systems (H.R. Rep. No. 93-1185, p.18 (1974)).

Below is a discussion of the technologies that the Agency is proposing as BAT under Section 1412 of the SDWA for the IOCs and SOCs. The proposed BAT were determined on the basis of an evaluation of removal efficiencies of available technologies for each of the contaminants, as well as the costs of installing BAT for large systems. The following discussion also indicates, for each contaminant, the proposed MCL and presents the Agency's rationale for selecting the proposed MCLs. In determining the proposed MCLs based on these technical and economic feasibility considerations, EPA also sought to ensure that the SDWA goal of providing safe drinking water is met.

#### 1. Inorganic Chemicals

Table 16 summarizes the treatment technologies which EPA evaluated and those it is proposing as BAT for

asbestos, barium, cadmium, chromium, mercury, nitrate, nitrite and selenium. Table 17 lists the efficiencies of removal, based on available treatment data, for each technology. Examination of these technologies indicates that, in general, each can reduce contaminant levels from the maximum occurrence levels (as indicated by EPA survey data) to the level of the proposed MCLs. Systems should note that not all technologies may remove contaminants at maximum influent concentrations to below the MCL. Most removal technologies have a range of removal efficiencies. All the BATs at the upper end of the removal efficiency range can remove contaminants to below the MCLs. Table 18 shows the removal efficiencies that would be required of BATs based upon the maximum expected range in influent to effluent concentrations. Influent concentrations correspond to maximum expected levels in drinking water sources, while effluent concentrations correspond to the proposed MCLs.

TABLE 16.—PROPOSED BEST AVAILABLE TECHNOLOGIES TO REMOVE INORGANIC CONTAMINANTS

Inorganic Contaminant	Best available technologies								
	Activated alumina	Coagulation/filtration	Corrosion control	Direct filtration	Diatomite filtration	Granular activated carbon	Ion exchange	Lime softening	Reverse osmosis
Asbestos.....		X	X	X	X				
Barium.....							X	X	X
Cadmium.....		X					X	X	X
Chromium III.....		X					X	X	X
Chromium VI.....		X					X		X
Mercury.....		X <sup>1</sup>				X		X <sup>1</sup>	X <sup>1</sup>
Nitrate and Nitrite.....							X		X
Selenium IV (Selenite).....	X	X						X	X
Selenium VI (Selenate).....	X							X	X

<sup>1</sup> BAT only if influent mercury concentrations do not exceed 10 ug/l. Coagulation/Filtration for mercury removal includes PAC addition or post-filtration GAC column where high organic mercury is present in source water.

TABLE 17.—BAT REMOVAL EFFICIENCIES

Inorganic contaminant	Best available technologies								
	Activated alumina	Coagulation/filtration	Corrosion control	Direct filtration	Diatomite filtration	Granular activated carbon	Ion exchange	Lime softening	Reverse osmosis
Asbestos.....		≥ 95	≥ 90	≥ 70-99	≥ 95				
Barium.....							93-98	90-95	92-98
Cadmium.....		80-95					90-99	98-99	96-98
Chromium III.....		90-99					90	99	82-97
Chromium VI.....		90-99					80-96		82-97
Mercury.....		≥ 40-90				80-100		≥ 60-80	≥ 80
Nitrate and Nitrite.....							75-99		67-95
Selenium IV (Selenite).....	85-95	80-85						45-50	75-99
Selenium VI (Selenate).....	85-95							10	75-99

Reference: U.S. EPA Technology and Cost Documents (11).

<sup>1</sup> BAT only if influent mercury concentrations do not exceed 10 ug/l. Coagulation/Filtration for mercury removal includes PAC addition or post-filtration GAC column where high organic mercury is present in source water.

<sup>2</sup> Removal efficiencies expected in reducing source water influent levels.

<sup>3</sup> Removal efficiencies expected as a corrosion control technique to prevent corrosion of pipe.



TABLE 18.—REQUIRED REMOVAL EFFICIENCIES TO MEET PROPOSED MCLGS

Contaminant	Maximum influent concentration	Proposed MCLG	Percent removal required to achieve MCLG
Asbestos <sup>1</sup>	10 MFL	7 MFL	30
Barium	5 mg/l	5 mg/l	0
Cadmium	0.045 mg/l	0.005 mg/l	89
Chromium	0.050 mg/l	0.1 mg/l	0
Mercury	0.01 mg/l <sup>2</sup>	0.002 mg/l	80
	0.10 mg/l	0.002 mg/l	98
Nitrate (as N)	100 mg/l	10 mg/l	90
Nitrite (as N)	10 mg/l	1 mg/l	90
Selenium	0.050 mg/l	0.05 mg/l	0

<sup>1</sup> Asbestos to be regulated at 7 million fibers/liter, for fibers greater than 10 microns in length.

<sup>2</sup> A level below maximum occurrence but applicable for the usage of some technologies.

Consistent with the legislative history of the SDWA, EPA generally assesses the removal capabilities of technologies as applied to relatively clean source waters.

However, to evaluate the removal capabilities of the IOC technologies, EPA evaluated the maximum occurrence level for these contaminants. Table 17 and 18 demonstrates that, even under the worst case assumption of the maximum occurrence levels, the proposed BATs are capable of reducing contaminant levels to below the MCLGs.

The costs for the removal of specific contaminants, (assuming the same influent to effluent levels cited in Table 18) using the proposed BATs are summarized in Table 19, 20, and 21. The general assumptions used to develop the treatment costs include: capital costs

amortized over 20 years at a 10 percent interest rate; engineering fees; contractor overhead and profit; late 1986 power, fuel, labor, and chemical costs.

Costs may vary from those shown, depending on local circumstances. But, based on available information, these costs are representative of typical system costs using BAT. Costs of treatment will be less than shown in Table 19 if contaminant concentration levels encountered in the raw water are lower than those used for the calculations. For example, if contaminant levels in the raw water is half of the maximum occurrence level then treatment costs could be expected to be approximately 20 to 50 percent lower than the cost in Table 21. However, costs of treatment will be higher if additional system-specific treatment or storage requirements are needed.

TABLE 19.—COST OF CONTAMINANT REMOVAL BY BAT

(Cents/1000 gallons, late 1986 dollars)

Contaminant/BAT	Population Served				
	25-100	500-1000	1001-3300	3300-10,000	> 1,000,000
<b>Asbestos</b>					
Direct Filtration	520	89	49	30	12
Direct Filtration, Modified	320	54	22	9	1
Coagulation/Filtration		120	59	29	8
Coag/Filtration, Modified <sup>1</sup>		18	8	7	1
Diatomite Filtration <sup>1</sup>	130	29	19	18	8
Corrosion Control					
pH adjustment (NaOH)					
—lime addition	170	29	14	8	1
—caustic soda addition	34	9	7	4	3
Alkalinity adjustment					
—soda ash addition	200	38	20	11	3
—sodium bicarbonate addition	190	38	21	13	5
Corrosion Inhibitor (ZnPO <sub>4</sub> )	41	11	5	4	1
<b>Barium</b>					
Ion exchange	230	90	63	54	26
Lime softening		230	130	130	61
Reverse osmosis	460	290	190	160	110
<b>Cadmium</b>					
Ion exchange	230	88	57	52	23
Reverse osmosis	460	250	190	160	110
Coagulation/Filtration		150	76	51	16
Coag/Filtration, Modified <sup>1</sup>		57	28	12	2
Lime softening		220	130	130	59
<b>Chromium</b>					
Coagulation/Filtration (III & VI)		140	81	45	13
Coag/Filtration, Chem. <sup>1</sup> (III & VI)		14	6	2	1
Ion exchange, two bed (III & VI)	340	110	64	62	23
Ion exchange (III)	200	86	53	39	13
Ion exchange (VI)	220	86	51	38	13
Lime softening (III)		220	130	88	55
Reverse osmosis (III & VI)	340	200	150	120	82
<b>Mercury, with 10 µg/l influent</b>					
Granular activated carbon <sup>1</sup>	200	62	45	52	31
Coagulation/filtration + act. carbon		210	130	130	54
Coagulation/filtration modif. w/PAC <sup>2</sup>		82	41	52	34
Lime softening, modifying <sup>1</sup>		43	21	9	1
Reverse osmosis	620	320	260	220	150
<b>Mercury, with 100 µg/l influent</b>					
Granular activated carbon <sup>2</sup>	210	67	50	59	34
<b>Nitrate and/or Nitrite</b>					
Ion exchange	340	150	130	110	77
Reverse osmosis	590	300	250	210	150
<b>Selenium</b>					
Reverse osmosis (IV & VI)	150	62	47	35	17
Activated alumina (IV)	410	76	41	19	6



TABLE 19.—COST OF CONTAMINANT REMOVAL BY BAT—Continued

(Cents/1000 gallons, late 1986 dollars)

Contaminant/BAT	Population Served				
	25-100	500-1000	1001-3300	3300-10,000	> 1,000,000
Lime softening modifying <sup>1</sup> (IV).....		73	41	24	11
Coagulation/Filtration (IV).....		71	40	19	3
Coag/Filtration, Modified Chem. <sup>1</sup> (IV).....		18	8	4	1
Activated alumina (VI).....	410	90	55	31	21

Note: Costs derived from EPA technology and costs document, cost supplement (10). Costs include waste disposal cost except where noted.

<sup>1</sup> Waste disposal costs not included.<sup>2</sup> PAC = Powdered Activated Carbon.TABLE 20.—ESTIMATED CAPITAL COSTS FOR IOC REMOVAL <sup>1</sup>

(Millions of dollars)

Contaminant/BAT	Population served		
	25-100	3,300-10,000	> 1,000,000
Asbestos:			
Direct Filtration.....	0.09	0.54	63
Coagulation/Filtration.....	0.17	0.54	120
Coag/Filtration, Modified <sup>1</sup> .....	0.01	0.16	0.70
Diatomite Filtration <sup>1</sup> .....	0.03	0.40	74
Corrosion Control			
pH adjustment (NaOH)			
—lime addition.....	0.03	0.18	1.1
—caustic soda addition.....	0.003	0.04	1.4
Alkalinity adjustment			
—soda ash addition.....	0.04	0.24	1.3
—sodium bicarbonate addition.....	0.04	0.21	1.3
Corrosion Inhibitor (ZnPO <sub>4</sub> ).....	0.005	0.08	0.42
Barium:			
Ion exchange.....	0.08	1.1	140
Lime softening.....	0.24	2.3	240
Reverse osmosis.....	0.10	2.7	860
Cadmium:			
Ion exchange.....	0.08	1.1	130
Reverse osmosis.....	0.10	2.6	890
Coagulation/Filtration.....	0.21	1.4	260
Coag/Filtration, Modified <sup>1</sup> .....	0.07	0.28	2.4
Lime softening.....		2.3	220
Chromium:			
Coagulation/Filtration (III & VI).....	0.19	1.1	210
Coag/Filtration, Chem. <sup>1</sup> (III & VI).....	0.01	0.03	0.26
Ion exchange, two bed (III & VI).....	0.08	1.4	260
Ion exchange (III).....	0.04	0.42	94

TABLE 20.—ESTIMATED CAPITAL COSTS FOR IOC REMOVAL <sup>1</sup>—Continued

(Millions of dollars)

Contaminant/BAT	Population served		
	25-100	3,300-10,000	> 1,000,000
Ion exchange (VI).....	0.04	0.58	165
Lime softening (III).....	0.24	1.1	190
Reverse osmosis (III & VI).....	0.08	1.8	660
Mercury, with 10 µg/l influent:			
Granular activated carbon <sup>1</sup> .....	0.056	0.56	91
Coagulation/filtration + act. carbon.....	0.24	2.7	540
Coagulation/filtration modif. w/PAC <sup>2</sup> .....	0.05	0.34	9.5
Lime softening, modifying <sup>1</sup> .....		0.23	1.3
Reverse osmosis.....	0.11	2.9	1,030
Mercury, with 100 µg/l influent:			
Granular activated carbon <sup>1</sup> .....	0.063	0.71	100
Nitrate and/or Nitrite:			
Ion exchange.....	0.10	1.7	340
Reverse osmosis.....	0.13	4.1	1,280
Selenium IV & VI:			
Reverse osmosis (IV & VI).....	0.03	0.45	150
Activated alumina (IV).....	0.12	0.38	45
Lime softening modifying dose (IV).....		0.23	1.30
Coagulation/Filtration (IV).....	0.05	0.34	52
Coag/Filtration, Modified Chem. <sup>1</sup> (IV).....	0.04	0.18	1.5
Activated alumina (VI).....	0.12	0.38	45

Note: Costs derived from EPA technology and costs document, cost supplement (10). Costs include waste disposal costs except where noted.

<sup>1</sup> Waste by-product disposal costs not included.<sup>2</sup> PAC = Powdered Activated Carbon.



TABLE 21.—ESTIMATED ANNUAL INCREASE IN HOUSEHOLD WATER BILLS FOR IOC REMOVAL

(Dollars household year)

Contaminant/BAT	Population served		
	25-100	3,300-10,000	>1,000,000
Asbestos			
Direct filtration .....	520	30	12
Direct filtration, modified .....	320	9	1
Coagulation/filtration .....		29	8
Coag/filtration, modified <sup>1</sup> .....		7	1
Diatomite filtration <sup>1</sup> .....	130	18	8
Corrosion control pH adjustment (NaOH) —lime addition .....	170	8	1
—caustic soda addition .....	34	44	3
Alkalinity adjustment —soda ash addition .....	200	11	3
—sodium bicarbonate addition .....	190	13	5
Corrosion inhibitor (ZnPO <sub>4</sub> ) .....	41	4	1
Barium			
Ion exchange .....	230	54	26
Lime softening .....		130	61
Reverse osmosis .....	460	160	110
Cadmium			
Ion exchange .....	230	52	23
Reverse osmosis .....	460	160	110
Coagulation/filtration .....		51	16
Coag/filtration, modified <sup>1</sup> .....		12	2
Lime softening .....		130	59

TABLE 21.—ESTIMATED ANNUAL INCREASE IN HOUSEHOLD WATER BILLS FOR IOC REMOVAL—Continued

(Dollars household year)

Contaminant/BAT	Population served		
	25-100	3,300-10,000	>1,000,000
Chromium			
Coagulation/filtration (III & VI) .....		45	13
Coag/filtration, chem. <sup>1</sup> (III & VI) .....		2	1
Ion exchange, two bed (III & VI) .....	340	62	23
Ion exchange (III) .....	200	39	13
Ion exchange (IV) .....	220	38	13
Lime softening (III) .....		88	55
Reverse osmosis (III & VI) .....	340	120	82
Mercury, with 10 ug/l influent Granular activated carbon <sup>1</sup> .....	200	52	31
Coagulation/filtration + act. carbon .....		130	54
Coagulation/filtration modif.w/ PAC <sup>2</sup> .....		52	34
Lime softening, modifying <sup>1</sup> .....		9	1
Reverse osmosis .....	620	220	150
Mercury, with 100 ug/l influent Granular activated carbon <sup>1</sup> .....	210	59	34
Nitrate and/or Nitrite Ion exchange .....	340	110	77
Reverse osmosis .....	590	210	150

TABLE 21.—ESTIMATED ANNUAL INCREASE IN HOUSEHOLD WATER BILLS FOR IOC REMOVAL—Continued

(Dollars household year)

Contaminant/BAT	Population served		
	25-100	3,300-10,000	>1,000,000
Selenium			
Reverse osmosis (IV & VI) .....	150	35	17
Activated alumina (IV) .....	410	19	6
Lime softening modifying (IV) .....		24	11
Coagulation/filtration (IV) .....		19	3
Coag/filtration, modified chem. <sup>1</sup> (IV) .....		4	1
Activated alumina (VI) .....	410	31	21

Note: Costs derived from EPA technology and costs document, cost supplement (10). Costs include waste disposal costs.

<sup>1</sup> Waste by-product disposal costs not included.

<sup>2</sup> PAC= Powdered Activated Carbon.

The costs in Table 20 include the lowest cost technology required for the treatment and disposal of waste by-products, except where noted in the table. The lowest cost waste disposal alternatives and associated costs, at several population ranges, are identified in Table 22. The disposal of waste by-products generated by the treatment processes increases overall treatment costs for all systems. Because EPA identifies the treatment and disposal technologies that are reasonably available for large metropolitan and regional drinking water systems (i.e., systems serving more than 100,000 persons), waste disposal does not significantly increase the total treatment costs for large systems.



TABLE 22.— LOWEST COST ALTERNATIVES FOR WASTE BY-PRODUCT DISPOSAL

[cents/1,000 gallons drinking water produced]

Treatment	Costs						
	Population	25-100	100-500	500-1,000	1,000-3,300	3,300-10K	>1,000,000
	Flow(mgd)	0.013	0.045	0.133	0.40	1.30	650
<b>SLUDGES:</b>							
Coagulation/filtration							
Sanitary Sewer Discharge							
—Selenium.....		190	62	28	15	5	1
—Chromium, Cadmium.....		190	55	27	12	4	0
—Mercury.....		230	77	35	18	7	1
Dewatering and Land Disposal <sup>1</sup> .....		300	120	55	30	20	7
Lime Softening							
Dewatering and Land Disposal <sup>1</sup> .....		550	240	120	80	60	40
Land Application.....		1200	380	150	80	50	60
Direct Filtration							
Dewatering and Land Disposal <sup>1</sup> .....		300	120	55	32	20	8
<b>BRINES:</b>							
Ion Exchange							
to Sanitary Sewer							
—Barium, Cadmium, Chromium.....		100	71	45	25	12	2
—Nitrate, Nitrite.....		93	62	37	20	10	2
—Selenium.....		82	52	30	16	8	1
Reverse Osmosis							
Direct Discharge.....		85	42	20	11	5	0
Sanitary Sewer.....		220	150	90	47	27	10
Activated Alumina—Selenium only							
Sanitary Sewer.....		170	70	35	18	9	3
Evaporation Pond/Landfill.....		300	150	100	80	30	20

Source: Draft, "Technologies and Costs for the Treatment and Disposal of Waste By-products from Water Treatments for the Removal of Inorganic and Radioactive Contaminants" (6).

<sup>1</sup> Dewatering by nonmechanical methods, e.g., lagoons or drying beds.

Brines are generated by ion exchange, reverse osmosis, and activated alumina. The most economical disposal methods for brines are sanitary sewer discharge or, for reverse osmosis, direct discharge of the concentrated waste stream to a receiving body of water. Because permits are needed to discharge brines to surface waters, the water system should contact the wastewater treatment plant prior to discharging brines to a sanitary sewer or the State National Pollution Discharge Elimination System (NPDES) authority for discharging directly to surface waters. Other possible alternatives include evaporation pond dewatering followed by land disposal, and chemical precipitation followed by nonmechanical dewatering (lagoons or drying beds) and land disposal. Sludges are generated by coagulation/filtration, direct filtration, green sand filtration, and lime softening. The most economical disposal method for sludges is discharge to the sanitary sewer. Again, the waste water treatment plant should be contacted prior to discharging to a sanitary sewer. An alternative option may be nonmechanical dewatering (lagoons or drying beds) followed by land disposal. Direct land application for lime softening wastes is also an alternative. Mechanical methods tend to be higher in cost, though technically feasible.

The selection of waste by-product disposal alternatives will be influenced by regulatory constraints and sitespecific conditions. Regulatory constraints include: industrial pretreatment requirements for sanitary sewer discharges, Resource Conservation and Recovery Act (RCRA) requirements for hazardous waste disposal, and effluent limitations for the discharge of some contaminants into local receiving waters (ground waters and surface waters). Site-specific conditions include the availability of sewage disposal, location of disposal sites, climatic factors, cost of land, other economic factors, and other local or regional factors including available manpower and infrastructure characteristics.

The following sections discuss the BAT(s) which EPA is proposing for each of the IOCs, as well as the Agency's rationale for deriving the proposed MCLs.

a. *Asbestos*—(1) *Technologies and Costs*. The Agency has determined that coagulation/filtration, direct filtration, and diatomite filtration are capable of removing asbestos (fiber lengths greater than 10 microns) from drinking water. These technologies fulfill the requirements of Section 1412 of the SDWA as BAT for removal of asbestos from contaminated source waters. Asbestos levels resulting from the

deterioration of asbestos cement (A/C) pipe can be reduced by an effective corrosion control program, including stabilization, utilizing calcium carbonate equilibrium and the addition of corrosion inhibitors.

The deterioration of A/C pipe in distribution systems is principally attributable to the water quality parameters of pH and hardness which contribute to the aggressiveness of water in relation to A/C pipe surfaces. At least one study that examined the incidence of asbestos fiber in distribution water concluded that A/C pipe tapping (i.e., new connections into the pipe network) is probably involved in causing high asbestos fiber concentrations (Millette et al., 1979). In areas where isolated and/or momentary instances of high asbestos fiber concentrations are reported, A/C pipe tapping is a probable major cause. Where A/C pipe is in place, the procedure of tapping into pipes may be modified such that the contaminated segment of water adjacent to the tapping could be released, pumped, or otherwise disposed of in order to prevent deterioration of drinking water quality. Corrosion control technology to prevent A/C pipe deterioration is described below.

*Corrosion Control*: Calcium carbonate saturation by adding lime prior to entry to the distribution system is effective in



preventing the loss of asbestos fibers from asbestos cement (A/C) pipe. The goal of this type of corrosion control is to achieve a chemical balance in the treated water so that neither excessive deposits of calcium carbonate nor A/C pipe deterioration will occur in the distribution system. Depending upon the raw water quality, corrosion control may require adjusting the pH and alkalinity. Lime, sodium hydroxide, soda ash and sodium bicarbonate are commonly used to adjust pH or alkalinity. Experience in actual distribution systems, field, and laboratory studies indicate that corrosion control measures can check the deterioration of A/C pipe and maintain the levels of asbestos fibers in the drinking water below the proposed MCL. Estimated costs for stabilizing the water with lime addition range from \$1.70/1,000 gallons treated for systems serving 25 to 100 persons to \$0.01/1,000 gallons treated for large systems (those systems serving more than 1,000,000 persons).

**Inhibitors.** Inhibitors added to the water to control leaching of asbestos fibers from A/C pipe accomplish this function by forming a protective film to serve as a barrier between the water and the A/C pipe surface. Zinc salts such as zinc chloride, zinc sulfate and zinc orthophosphate are suitable inhibitors to protect A/C pipe from aggressive waters. Recent developments in corrosion control indicate that zinc orthophosphate may be the most effective inhibitor since in addition to protecting A/C pipe, it can effectively prevent the corrosion of materials containing lead, copper, and cadmium. Estimated costs to use inhibitors ranges from \$0.41/1,000 gallons treated for small systems (serving 25 to 100 persons) to \$0.01/1,000 gallons treated for large systems.

Where source water is contaminated by asbestos (e.g., from natural geologic erosion, industrial discharge, mineral mining process wastes, etc.), the following filtration techniques are suitable for asbestos fiber removal.

**Coagulation/Filtration:** Studies show that coagulation/ filtration to remedy asbestos has been shown to be greater than 95 percent effective. Several large metropolitan systems remove asbestos using this technology, where turbidity reduction is also required. The construction of new coagulation/ filtration facilities is cost effective for large systems, especially if turbidity removal is also required. Existing coagulation/filtration treatment can be modified to increase removal efficiencies for asbestos fibers by

optimizing the coagulant dosage, pH, and/or adding polymers. Estimated costs to remove asbestos using conventional coagulation techniques, adjusting pH, and coagulant dosages in existing facilities range from \$0.18/1,000 gallons treated for systems serving 500 to 1,000 persons to \$0.01/1,000 gallons treated for large systems (i.e., those serving more than 1,000,000 persons). Construction and operation of new coagulation facilities to remove asbestos from drinking water are estimated to cost from \$1.20/1,000 gallons treated for systems serving 500 to 1,000 persons to \$0.08/1,000 gallons treated for large systems.

**Direct Filtration:** Actual plant operations and pilot plant studies show that direct filtration with proper chemical treatment is suitable to remove asbestos fibers. Modification of existing filtration plants to provide improved removal of existing turbidity and asbestos fibers is feasible and cost effective. This treatment method is feasible and cost effective for both small and large systems. Experience indicates that direct filtration removes 70 to 99 percent of asbestos. Estimated costs to remove asbestos by modifying existing filtration facilities range from \$3.20/1,000 gallons treated for small systems to \$0.01/1,000 gallons treated for large systems. Construction and operation of new direct filtration facilities results in costs ranging from \$0.89/1,000 gallons treated for systems serving 500 to 1,000 persons to \$0.12/1,000 gallons treated for large systems.

**Diatomite Filtration:** Removal of asbestos fibers by diatomite filtration has been shown to be greater than 95 percent efficient. Diatomite filtration is currently used in community water systems to filter relatively clean source waters. Estimated costs for the construction and operation of a diatomite filtration facility range from \$1.30/1,000 gallons treated for small systems to \$0.08/1,000 gallons treated for systems serving more than 1,000 persons. These costs exclude the cost of waste by-product disposal because they are small relative to overall costs.

#### (2) Proposed MCL for Asbestos

Each technology identified by EPA as BAT is highly efficient in removing asbestos, is currently available, is installed in public water supplies, and is compatible with other water treatment processes in use in different regions of the U.S. Based on the cost data summarized above, EPA believes that the costs to large systems of installing these technologies are reasonable. Furthermore, BAT can reduce asbestos from the maximum occurrence level of

10 million fibers/liter (MFL) to the proposed MCLG of 7 MFL, a level greater than the PQL of 0.1 MFL. Therefore, EPA is proposing the MCL at 7 MFL for fibers greater than 10 microns.

**b. Barium—(1) Technologies and Costs.** The Agency has determined that the technologies of ion exchange, lime softening and reverse osmosis are BAT for barium removal.

**Ion exchange:** Cation exchange to remove barium is considered BAT in part because of its demonstrated ability to reduce barium concentration levels down to or below the proposed MCLG at reasonable costs. Sodium cation exchange resins and ion exchange equipment are readily available commercially. Sodium cation exchange is successfully used in water treatment facilities to remove 93 to 98 percent of barium from water. Ion exchange treatment is feasible for all system sizes. Barium removal by ion exchange to reduce the concentration in water by 75 to 80 percent ranges from \$2.30/1,000 gallons for small systems to \$0.26/1,000 gallons for large systems. Blending of source and finished waters, where initial barium concentrations are low enough to allow, significantly reduces ion exchange capital requirements and operating costs.

**Reverse Osmosis:** Reverse osmosis (RO) utilizes semi-permeable membranes to remove a high percentage of almost all inorganic ions, including barium. Most organic matter is also removed, with the exception of many halogenated and low-molecular-weight compounds. This technology is considered BAT for barium because it is effective in removing barium (and other dissolved inorganic substances) at feasible costs. RO is used as a treatment method to reduce contaminants other than barium. Pilot plant studies and laboratory tests indicated that RO can remove 92 to 98 percent of barium.

The estimated cost of using RO to reduce barium levels in surface water sources by 75 to 80 percent ranges from \$4.60/1,000 gallons in small systems to \$1.10/1,000 gallons in large systems.

RO performance is adversely affected by the presence of turbidity, iron, manganese, silica, or scale producing constituents in source water. If pretreatment does not exist to remove these constituents, the cost to install the pretreatment technologies (e.g. pH adjustment, filtration, or scale prevention additives) may be considerable.

In situations where high dissolved solids and/or other contaminants may have to be removed in addition to barium, the RO process may offer an



especially desirable and cost effective approach. If the influent concentration of contaminants allows partial treatment and blending, the above costs may be significantly lower.

**Lime Softening:** Lime softening can achieve 90 to 95 percent removal of barium at optimum pH levels ranging between 9.2 and 11.6, as indicated by laboratory and pilot plant studies. Lime softening is used on a full scale basis to reduce contaminants other than barium. Estimated costs of lime softening to reduce barium concentrations in surface water sources by 75 to 80 percent range from \$2.30/1,000 gallons for systems serving 500 to 1,000 persons to \$0.61/1,000 gallons for large systems.

(2) **Proposed MCL for Barium.** All of the above barium removal technologies demonstrate high removal efficiencies, are currently available in all geographic regions, have been installed in public water systems, are compatible with other water treatment processes, and can achieve compliance for all the system's water. Based on the cost data summarized above, EPA believes that the costs of these technologies to large systems are reasonable. The MCLG for barium is 5 mg/l. This concentration is equal to the maximum reported occurrence level for this contaminant in drinking water. EPA is proposing to set the MCL equal to the proposed MCLG (5 mg/l). This level is above the PQL.

**c. Cadmium—(1) Technologies and Costs.** The Agency proposes that ion exchange, coagulation/filtration, lime softening and reverse osmosis fulfill the requirements of the SDWA as BAT for cadmium removal.

**Ion Exchange:** Cation exchange is BAT, in part, because it can reduce cadmium levels from maximum occurrence levels to the proposed MCLG at reasonable costs. Sodium cation exchange resins and ion exchange equipment are readily available commercially. Field and pilot plant studies demonstrate that sodium cation exchange can remove 90 to 99 percent of cadmium. (Ion exchange treatment is effective for all system sizes.) Ion exchange to remove cadmium in small systems is \$2.30/1,000 gallons and \$0.23/1,000 gallons for large systems. Blending significantly reduces ion exchange capital requirements and operating costs since only a portion of the raw water must be treated.

**Reverse Osmosis:** RO utilizes semi-permeable membranes to remove a high percentage of almost all inorganic ions, including cadmium. Most organic matter is also removed with the exception of some halogenated and low-molecular-weight compounds. This technology is BAT because it is effective in removing

cadmium at feasible costs. RO is widely used on a full scale basis to reduce other contaminants. Pilot studies demonstrate that RO can remove 96 to 98 percent of cadmium. Using RO to reduce cadmium costs \$4.60/1,000 gallons for small systems and \$1.10/1,000 gallons for large systems.

RO performance is adversely affected by turbidity, iron, manganese, silica, or scale producing constituents in source water. If pretreatment does not exist to remove these constituents, the cost to install the pretreatment technologies (e.g., pH adjustment, filtration, or scale prevention additives) may be considerable.

If high dissolved solids or other contaminants must be removed in addition to cadmium, RO is especially desirable and cost effective. If the influent concentrations allow the partial treatment and subsequent blending of water, the above costs for treatment may be significantly lower.

**Lime Softening:** Laboratory and pilot plant studies have demonstrated that lime softening can remove 98 to 99 percent of cadmium at pH levels ranging between 8.5 and 11.5. This technology is BAT because it has been demonstrated to be capable of reducing cadmium concentrations from maximum occurrence levels to the proposed MCLG level. Lime softening is widely and effectively used in water treatment plants to reduce hardness. Estimated costs of providing new lime softening facilities to reduce cadmium range from \$2.20/1,000 gallons for systems serving 500 to 1,000 persons to \$0.59/1,000 gallons for very large systems.

**Coagulation/Filtration:** Laboratory and pilot plant studies show that conventional coagulation using alum and, in some cases, ferric sulfate coagulant, achieves 80 to 95 percent cadmium removal at pH levels of 8.0 or above. Several studies referenced in EPA technology and cost documents suggest that site-specific raw water quality indicators, such as pH, significantly affect removal efficiencies. Data are not available which identify optimum operating conditions for coagulation/filtration treatment to remove cadmium. This technology is BAT because it is capable of reducing cadmium concentrations to below the proposed MCL. Coagulation/filtration has been used on a full scale basis to reduce other contaminants such as turbidity, particulate matter, and microbial contaminants. Estimated costs of reducing cadmium using coagulation/filtration range from \$1.50/1,000 gallons for systems serving 500 to 1,000 persons to \$0.16/1,000 gallons for large systems.

(2) **Proposed MCL for Cadmium.** The technologies described above are highly efficient in removing cadmium from drinking water, are currently available, are installed in public water systems, and are compatible with other water treatment processes in different regions of the U.S. Based on the cost data summarized above, EPA believes the costs for large systems to install ion exchange, lime softening, coagulation/filtration and RO treatment are reasonable. Each of these technologies can reduce cadmium from the maximum levels of occurrence of 0.045 mg/l to the proposed MCLG of 0.005 mg/l. The MCLG proposed is at a level which is greater than the PQL. Therefore, EPA is proposing the MCL for cadmium at 0.005 mg/l.

**d. Chromium—(1) Technologies and Costs.** Ion exchange, reverse osmosis, coagulation/filtration and lime softening fulfill the SDWA requirements as BAT to remove chromium. Successful installation of several technologies is dependent upon the valence or oxidation state of the chromium present. Chromium is present in water in a trivalent (Cr III) state as a cation, or in a hexavalent (Cr VI) state.

**Ion Exchange:** The valence of the chromium ions significantly affects the type of ion exchange resin used for removal. Removal of Cr III requires a cation exchange resin while removal of Cr VI requires the use of an anion exchange resin. Laboratory and field studies indicate that both resins are effective for removing chromium from drinking water. Ion exchange softening using standard strong acid synthetic resin and sodium chloride as a regenerant effectively removes Cr III with a 90 percent or greater efficiency. Pilot plant studies indicate that strong base resins are capable of removing 80 to 96 percent of Cr VI. Ion exchange technology is considered BAT in part because of its demonstrated ability to reduce chromium concentrations to levels at or below the proposed MCLG at feasible costs. Treatment is feasible for all system sizes. Removal costs of Cr III from surface waters by cation exchange range from \$2.00/1,000 gallons for small systems to \$0.13/1,000 gallons for large systems. Removal costs of Cr VI from surface waters by anion exchange ranges from \$2.20/1,000 gallons for small systems to \$0.13/1,000 gallons for large systems. Cost effective operation of this technology is dependent upon the amount and proportion of chromium valence species present. If removing both chromium species is required, installation of a cation exchanger in series with an anion



exchanger is required. Costs to operate a two-bed ion exchange system to reduce total chromium levels from surface water by 50 percent ranges from \$3.40/1,000 gallons for small systems to \$0.23/1,000 gallons for large systems.

**Reverse Osmosis:** RO utilizes semi-permeable membranes to remove a high percentage of almost all inorganic ions, including chromium. Most organic matter is also removed, with the exception of many halogenated and low molecular weight compounds. This technology is considered BAT because it has been demonstrated to be effective in removing chromium (and other dissolved inorganic substances) at feasible costs. RO is used on a full scale basis to reduce contaminants other than chromium. Pilot plant studies demonstrate that RO can remove 82 to 97 percent of chromium. Reducing chromium in surface water sources by 50 percent (assuming pretreatment is in place) ranges from \$3.40/1,000 gallons in small systems to \$0.82/1,000 gallons in large systems.

RO performance is adversely affected by the presence of turbidity, iron, manganese, silica, or scale producing constituents in source water. If pretreatment does not exist to remove these constituents, the cost of installing pretreatment technology (e.g., pH adjustment, filtration, or scale prevention additives) may be considerable.

The RO process is especially desirable and cost effective in situations where high dissolved solids and other contaminants must be removed in addition to chromium. If chromium influent concentration levels allow partial treatment and blending of the water, the above estimated costs may be significantly lower.

**Lime Softening:** Lime softening can achieve 72 to 99 percent removal of Cr III. At pH levels of 11 to 11.5, pilot plant tests achieved 99 percent Cr III removal. The same studies showed that lime softening is ineffective in removing Cr VI to 20 µg/l. Lime softening has been used on a full scale basis to reduce contaminants other than chromium. Estimated lime softening costs to reduce Cr III concentrations from surface water sources by 50 percent ranges from \$2.20/1,000 gallons for systems serving 500 to 1,000 persons to \$0.55/1,000 gallons for large systems.

**Coagulation/Filtration:** Laboratory and pilot plant studies indicate that conventional coagulation using ferric sulfate or alum as a coagulant achieves 90 to 99 percent chromium removal. The same studies showed that while ferric sulfate and alum are ineffective for removal of Cr VI, the use of ferrous

sulfate as a coagulant removes up to 98 percent of Cr VI. This technology is considered BAT L because it has been demonstrated to be capable of reducing chromium concentrations to meet the proposed MCLG. Estimated costs of reducing chromium levels from surface water sources by 50 percent by using conventional coagulation/filtration techniques range from \$1.40/1,000 gallons for systems serving 500 to 1,000 persons to \$0.13/1,000 gallons for large systems.

(2) **Proposed MCL for Chromium.** The technologies identified above are highly efficient in removing Cr III and Cr VI, either singly or together; are currently available; have been installed in public water systems; are compatible with other water treatment processes in various regions of the U.S.; and can achieve compliance for all the system's water. Based on the above cost data, EPA believes that the large systems BAT costs to remove chromium are reasonable. EPA is proposing the MCL equal to the proposed MCLG of 0.1 mg/l. This level is above the PQL.

**e. Mercury—(1) Technologies and Costs.** Reverse osmosis, lime softening, granular activated carbon (GAC), and coagulation/filtration, modified by the addition of powdered activated carbon (PAC) or post-filtration GAC, fulfill SDWA requirements as BAT for mercury removal. Occurrence data indicates that maximum concentration levels of total mercury (inorganic and organic) in U.S. waters rarely exceed 10 µg/l. At an influent concentration level above 10 µg/l only GAC sufficiently removes mercury to comply with the proposed MCL.

**Granular Activated Carbon (GAC):** Pilot plant and laboratory studies indicate GAC can remove 80 to 100 percent of organic and inorganic mercury. The same studies also show that GAC adsorbs organic mercury better than the inorganic mercury ion. Therefore, if both organic and inorganic mercury are present in the water, replacement of the GAC bed will be governed by inorganic mercury breakthrough. GAC is considered BAT, in part, because it is capable of reducing mercury influent concentrations above 10 µg/l to effluent concentrations of 2 µg/l. Removal efficiencies are affected by contact time within the GAC bed and the volume of water treated. GAC is also used in water treatment plants to reduce other contaminants in drinking water. Estimated costs to reduce mercury from 100 µg/l to 2 µg/l by GAC range from \$2.10/1,000 gallons treated for small systems to \$0.34/1,000 gallons treated for large systems.

The following BAT technologies all reduce levels of mercury from relatively clean source water (i.e., mercury levels in the untreated water do not exceed .01 mg/l) to achieve compliance with the proposed MCL.

**Reverse Osmosis:** RO utilizes semi-permeable membranes to remove a high percentage of almost all inorganic ions, including mercury. Most organic matter is also removed, with the exception of many halogenated and low molecular weight compounds. This technology is considered BAT because it has been demonstrated to be effective in removing mercury (and other dissolved inorganic substances) at feasible costs. RO is capable of removing 80 percent of mercury. RO is currently used in water treatment plants to reduce contaminants other than mercury. Pilot plant studies demonstrated the effectiveness of RO to remove mercury. Estimated costs to reduce mercury by RO from 10 µg/l to 2 µg/l range from \$6.20/1,000 gallons treated in small systems to \$1.50/1,000 gallons treated in large systems.

RO performance is adversely affected by the presence of turbidity, iron, manganese, silica, or scale producing constituents in source water. If pretreatment does not already exist, the cost of installing technology (e.g., pH adjustment, filtration, or scale prevention additives) may be considerable.

The RO process is especially desirable and cost effective in situations where high dissolved solids and other contaminants must be removed in addition to mercury. If mercury influent concentration levels allow partial treatment and blending of water, the above estimated costs may be significantly lower.

**Lime Softening:** Laboratory studies show lime softening achieves 60 to 80 percent removal of inorganic mercury, provided pH levels are maintained between 10.7 and 11.4. The same studies show that lime softening is ineffective in removing organic mercury. Using this technology is limited to systems where reducing inorganic mercury is necessary to comply with the mercury MCL. Estimated costs to reduce inorganic mercury in surface waters from 10 µg/l to 2 µg/l by modifying the lime softening feed rate at existing treatment plants range from \$0.43/1,000 gallons treated for systems serving 500 to 1,000 persons to \$0.01/1,000 gallons for large systems.

**Coagulation/Filtration:** Laboratory and pilot plant studies demonstrate that conventional coagulation using ferric sulfate achieves 40 to 90 percent removal of inorganic mercury. The use of alum coagulant achieves 30 to 60



percent removal of inorganic mercury. Removal efficiencies are significantly affected by source water turbidity (i.e., inorganic mercury removal increases with turbidity removal by coagulation/filtration). Mercury removal using both iron and aluminum coagulants tends to be less efficient at pH ranges of 6.5 to 9.0.

The same laboratory studies also found that conventional coagulation was not effective in removing organic mercury. However, modification of conventional coagulation by adding powdered activated carbon (PAC) to influent feed water, or adding a post-filtration GAC column, can improve total mercury removal efficiency to over 80 percent. Estimated costs to reduce mercury from surface water sources from 10 µg/l to 2 µg/l by modifying coagulation/filtration treatment by adding PAC ranges from \$0.82/1,000 gallons treated for systems serving 500 to 1,000 persons to \$0.34/1,000 gallons treated for large systems. Estimated costs to reduce mercury from surface water sources from 10 µg/l to 2 µg/l using coagulation/filtration with GAC post-treatment range from \$2.10/1,000 gallons treated for systems serving 500 to 1,000 persons to \$0.54/1,000 gallons treated for large systems.

(2) *Proposed MCL for Mercury.* Each of the above treatment technologies efficiently removes mercury, is currently available, is installed in public water systems, and is compatible with other water treatment processes in different regions of the U.S. EPA believes that the cost to large systems to install each of the identified BATs is reasonable. All the above technologies reduce mercury from influent concentration levels of 0.01 mg/l to the proposed MCLG of 0.002 mg/l. However, only GAC effectively reduces mercury from concentration levels above 0.01 mg/l to the MCLG level of 0.002 mg/l, a level greater than the PQL. Therefore, only GAC is BAT when influent concentrations exceed 0.01 mg/l. Therefore, EPA is proposing the MCL at 0.002 mg/l.

f. *Nitrate and Nitrite—(1) Technologies and Costs.* Ion exchange and RO fulfill the SDWA requirements as BAT for nitrate/nitrite removal. Both technologies have high nitrate and nitrite removal capacity, are effective in reducing nitrate and nitrite maximum occurrence levels to the proposed MCLG level, and their costs are reasonable for large public water systems.

Another method (though EPA is not defining it as BAT) which may be used for elimination of excess nitrites in source water is chemical oxidation (e.g., breakpoint chlorination) which converts nitrites to nitrates. If the nitrite

concentration exceeds the allowable level and the nitrate concentration is low, then oxidation or breakpoint chlorination (though EPA is not defining it as BAT) may be more economical than RO or ion exchange, unless the nitrate concentration after oxidation exceeds the allowable or treatable level. Since anion exchange resins and RO membranes can be sensitive to chemical oxidants, the point of oxidant injection should be after the ion exchange or RO unit. Approximately 5 parts of chlorine are required to oxidize 1 part of nitrite. Since nitrite in source water is generally indicative of recent sewage or animal waste contamination, breakpoint chlorination is recommended, although oxidation is not specified as a BAT for meeting nitrate and nitrite MCLs.

*Ion Exchange:* Nitrate and nitrite removal using anion exchange resins as a reversible exchange medium exchanges nitrate and nitrite with chloride ions from the exchange resins. The efficiency and cost of nitrate and nitrite removal by ion exchange is significantly affected by sulfate ions. Because sulfate ions are preferred over nitrate and nitrite by the ion exchange medium, high sulfate source waters increase the load on the resin and result in more frequent sodium chloride regeneration. Field studies demonstrate that nitrate and nitrite removal using ion exchange is effective in water containing concentrations of sulfates as high as 380 mg/l.

Anion exchange has been demonstrated to remove 75 to 99 percent of influent nitrate and nitrite. The same ion exchange resins which remove nitrate also remove nitrite. However, since the resins exhibit a greater preference for nitrate, nitrite breakthrough occurs before the nitrate breakthrough. Therefore, if both nitrate and nitrite are present the anionic resins capacity for nitrite governs the treatment and regeneration cycles.

The costs of removing nitrate and nitrite from ground water using ion exchange technology ranges from \$3.40/1,000 gallons treated for small systems to \$0.77/1,000 gallons treated for large systems. Blending significantly reduces ion exchange capital requirements and operating costs. Blending is effective if a portion of the water is treated by breakpoint chlorination to remove nitrite while another portion is treated by ion exchange to reduce nitrate.

*Reverse Osmosis:* RO utilizes semi-permeable membranes to remove a high percentage of almost all inorganic ions, including nitrate and nitrite. Most organic matter is also removed, with the exception of many halogenated and low molecular weight compounds. RO is

capable of removing up to 95 percent of nitrate and nitrite at feasible costs. RO is widely used to reduce contaminants other than nitrate and nitrite. Pilot plant studies using RO have demonstrated effective reduction of nitrate and nitrite. Nitrate/nitrite removal from ground water using RO ranges from \$5.90/1,000 gallons treated in small systems to \$1.50/1,000 gallons treated in large systems.

RO performance is adversely affected by the presence of turbidity, iron, manganese, silica, or scale producing constituents in source water. If pretreatment does not already exist, the cost to install the technology (e.g., pH adjustment, filtration, or scale prevention additives) may be considerable.

The RO process is especially desirable and cost effective in situations where high levels of dissolved solids and other contaminants must be removed in addition to nitrate/nitrite. If influent concentration levels of nitrate/nitrite allow partial treatment and blending of water, the above estimated costs may be significantly lower.

(2) *Proposed MCL for Nitrate and Nitrite.* Ion exchange and RO are BAT for nitrate and nitrite removal because both are effective at removing nitrate and nitrite, are currently available and have been installed in public water systems, and are compatible with other water treatment processes in use in different regions of the U.S. In addition, oxidation techniques which convert nitrite to nitrate may be used. Based on the above cost data, EPA believes the treatment cost to a large system is reasonable. Ion exchange and RO can reduce the nitrate/nitrite levels from influent levels of up to 100 mg/l and 10 mg/l to the MCLGs of 10 mg/l and 1 mg/l, respectively. These MCLG levels are greater than the PQL of 0.4 mg/l. Therefore, EPA is proposing the MCL for nitrate and nitrite at 10 mg/l and 1 mg/l, respectively, and a joint standard of 10 mg/l.

g. *Selenium—(1) Technologies and Costs.* The Agency proposes that activated alumina, lime softening, coagulation/filtration, and reverse osmosis fulfill the requirements of the SDWA as BAT for selenium removal. Activated alumina and reverse osmosis are effective in removing selenium IV (selenite) and selenium VI (selenate) from drinking water. Though lime softening and conventional coagulation have a limited capacity for removing selenium VI, these two technologies are used successfully when reduction of selenium IV is sufficient to meet the selenium MCL.



**Activated Alumina:** The efficiency and cost of selenium removal is significantly affected by the valance state of selenium. Laboratory studies indicate that though activated alumina has a higher capacity for removing selenium IV than selenium VI, this technology is capable of removing 85 to 95 percent of both selenium IV and VI. For small systems this technology may not be cost effective because of special operational requirements. Activated alumina, when not used properly, leaches significant quantities of alumina into the finished water. Therefore, this technology is only recommended where adequate surveillance and maintenance are available.

Successful and cost-effective operation depends upon pH adjustment of the feed water to an optimum range. At the optimum the selenium ion exchanges with hydroxy ion contained in the activated alumina. A second key factor in successful and economical operation is regeneration by sodium hydroxide of the exhausted activated alumina bed to its original state. Selenium adsorption utilizing activated alumina is considered BAT, in part, because it reduces selenium IV and VI concentrations levels to or below the proposed MCLG at feasible costs.

Selenium IV removal from surface water sources by activated alumina ranges from \$4.10/1,000 gallons for small systems to \$0.06/1,000 gallons for large systems. Selenium VI removal from surface water sources by activated alumina ranges from \$4.10/1,000 gallons for small systems to \$0.21/1,000 gallons for large systems.

**Reverse Osmosis:** RO utilizes semi-permeable membranes to remove a high percentage of almost all inorganic ions, including selenium. Most organic matter is also removed, with the exception of some halogenated and low molecular weight compounds. This technology is considered BAT because it is effective for removing selenium (and other dissolved inorganic substances) at feasible costs. Reverse osmosis has been used on a full scale basis to reduce contaminants other than selenium. Pilot plant studies demonstrate that RO can remove 75 to 99 percent selenium. Costs for reducing selenium by RO by 10 percent range from \$1.50/1,000 gallons in small systems to \$0.17/1,000 gallons in large systems. This technology is especially desirable where high dissolved solids and other contaminants must be removed in addition to selenium.

**Lime Softening:** Lime softening achieves partial removal of selenium IV. At a pH of 11.5, laboratory tests achieved a 45 to 50 percent removal of

selenium III. Up to 10 percent of selenium VI is removed by lime softening. This technology is considered BAT because it is effective in reducing selenium concentration levels. Lime softening has been used on a full scale basis to reduce contaminants other than selenium from drinking water. Estimated costs of modifying current lime softening treatment to reduce influent selenium IV concentrations by 10 percent in a surface water source range from \$0.73/1,000 gallons for systems serving 500 to 1,000 persons to \$0.11/1,000 gallons for large systems.

**Coagulation/Filtration:** Laboratory and pilot plant studies demonstrate that coagulation using ferric sulfate as a coagulant removes 80 to 85 percent of selenium IV. This technology is considered BAT in those situations where reducing selenium IV is sufficient to reduce the total selenium concentration. Coagulation/filtration is used on a full scale basis to reduce contaminants other than selenium. The estimated costs of using coagulation/filtration to reduce selenium IV from surface water sources by 10 percent ranges from \$0.71/1,000 gallons for systems serving 500 to 1,000 persons to \$0.03/1,000 gallons for large systems.

(2) **Proposed MCL for Selenium.** Each of the technologies described above effectively removes selenium from drinking water, is currently available, has been installed in public water systems, and is compatible with other water processes in use in different regions of the U.S. Because the maximum occurrence level of 50 µg/l equals the proposed MCLG, all systems should be able to meet with the MCL without treatment. If treatment is necessary, the cost data summarized above indicate that costs to large systems are reasonable. The MCLG is greater than the PQL. Therefore, EPA is proposing the MCL at the MCLG level of 0.05 mg/l.

## 2. Synthetic Organic Chemicals

The following section discusses EPA's consideration of technologies to remove SOC's and the Agency's determination of proposed BAT's for the SOC's in this notice. In addition, this section discusses the Agency's rationale for the proposed MCLs. The rationale considers treatment technologies, costs, analytical method performance, and the goal of the SDWA to reduce health risks.

a. **Treatment Technologies.** EPA examined a number of technologies for their potential to remove the proposed SOC's. These technologies are discussed in the document "Technologies and Costs For The Removal of Synthetic Organic Chemicals From Potable Water

Supplies" (referred to below as the SOC T&C document). A more complete description of the technologies evaluated can be found in the November 13, 1985 Federal Register Notice (50 FR No. 219, Nov. 13, 1985, p. 46902).

**Activated Carbon:** Activated carbon is used to treat all the SOC's. The sole exception is epichlorohydrin for which no treatability information exists. Extensive bench-scale testing either in the form of isotherm or dynamic minicolumn testing has been performed. Some pilot and several full-scale evaluations have also been performed. Several of the full-scale evaluations involved either partial replacement of media filters with carbon or powdered activated carbon (PAC) in conjunction with coagulation/sedimentation.

Extensive testing of carbon absorption indicates it is effective in removing a broad spectrum of SOC's. Therefore, it is the most feasible technology in removing SOC's from drinking water and is considered a best available technology.

**Aeration:** Aeration has been successfully used to test 15 of the SOC's. These tests primarily involved pilot-scale testing of air stripping equipment. The 15 SOC compounds tested represent the more volatile SOC's, many of which are chlorinated solvents. Studies show aeration is as effective as GAC in removing some volatile SOC's and is therefore a best available technology for certain contaminants.

**Reverse Osmosis:** Reverse osmosis along with other membrane technologies such as ultrafiltration (UF) has been tested for removal of 15 SOC's from water. Tests were primarily bench scale, although some pilot-scale evaluations were recently conducted. While some SOC removals were reported, especially for pesticides, it was not always clear whether the removal was a result of rejection by the membrane or adsorption onto the membrane. Some bench-scale tests indicate that adsorption of particular SOC's may occur, and that once adsorption has occurred, desorption may be difficult.

Because there is limited treatability information on RO (much of which is bench scale) and because there is some question as to how SOC removal occurs, RO is not considered a best available technology. Rather it should be considered as an additional technology which requires further development.

**Oxidation:** A number of oxidants are available for removing SOC's in drinking water. These include ozone, chlorine, chlorine dioxide, permanganate, hydrogen peroxide, and ultraviolet light (UV) (either by itself or in combination



with any of the other oxidants). The ultimate end-product of complete oxidation is carbon dioxide and water, but the mechanism rarely goes to completion, as intermediate compounds formed during oxidation may be more resistant to oxidation. Currently, limited data is available on removing SOC by oxidation.

Oxidation has been used to treat 20 SOC, primarily using bench-scale evaluations. Oxidation techniques which were evaluated include ozone, chlorine, chlorine dioxide, hydrogen peroxide, potassium permanganate, and ultraviolet light (either alone or in combination with some of the other oxidants).

While oxidation may be effective in degrading certain SOC (especially those with unsaturated bonds), EPA has considerable concern about the degradation products formed by the partial oxidation of some SOC. Because there is limited treatability information on oxidation, much of which is bench scale, oxidation is not considered best available technology. Rather it should be considered as an additional technology that requires further development.

Ozonation has been the most widely tested oxidant because of its use in Europe since the early 1900s as a disinfectant. Currently, about 3,000 facilities worldwide utilize ozone for water treatment. Approximately 40 U.S. treatment plants utilize ozonation for disinfection, color destruction, taste and odor control, and THM (trihalomethane) precursor removal.

Ozone is the most powerful oxidant of the group of commonly used water treatment chemicals. The degree and rate of oxidation depends on the type of SOC, ozone dosage, pH, carbonate alkalinity, other competing organics present, and contact time. In some cases, reports of good destruction of SOC by ozone are more correctly attributable to air stripping of the compound.

Hoigne and Bader (1979) suggest that at a pH less than 9, ozone remains in solution as  $O_3$  and selectively oxidizes SOC. At a higher pH, initiated by hydroxide ions, ozone will decompose rapidly into free radicals, highly reactive and short-lived species, which react non-selectively with oxidizable compounds.

Frank (1985), and others report the ability of ozone to remove aromatic compounds and alkenes in direct proportion to ozone dosage, and the ineffectiveness of ozone for alkane removal. In general, alkenes are more reactive than aromatics, which in turn are more reactive than alkanes. The

apparent reason is that ozone is known to react at points of unsaturation. Alkenes are straight chain (aliphatic), unsaturated hydrocarbons, such as cis- and trans-1,2-dichloroethylene. The aromatics are closed rings of carbon atoms containing double bonds, e.g., toluene and xylene, and are susceptible to oxidation at the double bond. The alkanes, however, are aliphatic compounds with no double bonds, such as DBCP and 1,2-dichloropropane, thus are less susceptible to ozone attack.

With alkenes, destruction decreases with increasing halogen substitutions. A pH increase appears to enhance oxidation. Increasing the ozone dosage improves destruction of alkenes over a wide range of pH. Destruction of aromatics increases in proportion to ozone dose, but is not affected by a change in pH. Alkanes are removed little at low pH regardless of ozone dose, but at pH greater than 9, destruction is enhanced by increasing the ozone dose as free radical reactions occur.

The economic feasibility of ozonation appears to be favorable. The doses for oxidation are generally in the range of 6 mg/l which is three to four times the normal (1.5 to 2.0 mg/l) dose for disinfection and oxidation. Ozonation has the advantage of serving a dual role of disinfection and oxidation, and this may make it an attractive technology for certain systems depending on raw water quality, system size, and other factors. Even though there are still questions regarding reaction kinetics and by-products, it is a promising technology which may be a BAT in the future for particular compounds or groups of compounds. EPA encourages research and welcomes comments on this technology.

#### *Powdered Activated Carbon:*

Powdered activated carbon (PAC) is considered an applicable method of applying carbon adsorption to remove SOC. PAC can be added either through dry feed machines or as a carbon slurry. PAC is most frequently used for taste and odor control in conventional coagulation/filtration plants treating surface water since it requires the same facilities (feed equipment, mixing chambers, clarifiers, and filtration) as those plants, as well as additional sludge handling capabilities. Unless these facilities are already in place, PAC is generally not economically feasible to treat drinking water. For the above reasons, GAC is generally the preferred process for ground water systems.

Unlike GAC adsorption, in which the carbon in the bed approaches equilibrium with the influent SOC concentration, PAC approaches

equilibrium with the effluent SOC concentration since it is removed by a settling or filtration process. With the same influent concentration therefore, PAC will have a lower adsorptive capacity than GAC. However, if an SOC enters a surface water source periodically, such as a pesticide or herbicide used on a seasonal basis, PAC can be brought on-line at that time to meet the need, whereas GAC systems must generally remain on-line.

Pilot- and full-scale studies of PAC effectiveness give mixed results, though most studies to date agree that PAC has applicability primarily in locations which have physical constraints (e.g., hydraulic or space). Fewer studies on using PAC to remove organics found in ground water have been conducted primarily because of the need for very large doses of PAC to achieve necessary organic removals. Because of the above reasons, EPA is not defining PAC as BAT at this time.

#### *Conventional Treatment:*

Conventional treatment (coagulation/sedimentation/filtration) was used to treat ten SOC, six of which have been evaluated in full-scale installations. The removals for most SOC were poor, typically less than ten percent. It should be noted that influent concentrations in much of this testing were very low, typically less than 5 µg/L.

Since conventional treatment is of limited effectiveness in removing SOC it is not considered best available technology. Rather it should be considered as an additional technology of limited applicability.

#### *b. SOC Best Available Technologies.*

In the 1986 SDWA amendments, Congress specified in section 1412(b)(5) of the Act that:

Granular activated carbon is feasible for the control of synthetic organic chemicals, and any technology, treatment technique, or other means found to be the best available for the control of synthetic organic chemicals must be at least as effective in controlling synthetic organic chemicals as granular activated carbon.

EPA considered five basic treatment technologies to remove SOC: GAC, aeration, RO, oxidation, powdered activated carbon, and conventional treatment. In the Agency's judgement, only GAC and PTA are considered BAT for SOC removal at this time. A detailed discussion of GAC and PTA is discussed below.

Polymer addition practices (PAP) is proposed as a treatment technique for control of acrylamide and epichlorohydrin (see discussion in Section IV-C, below). The proposed BATs, either GAC, PTA, PAP, or a



combination, for each of the SOC's are listed in Table 23.

TABLE 23.—PROPOSED BAT FOR SOC'S

SOC	BAT <sup>1</sup>
Acrylamide.....	PAP
Alachlor.....	GAC
Aldicarb.....	GAC
Aldicarb sulfone.....	GAC
Aldicarb sulfoxide.....	GAC
Atrazine.....	GAC
Carbofuran.....	GAC
Chlordane.....	GAC
Dibromochloropropane (DBCP).....	GAC, PTA
1,2-Dichloropropane.....	GAC, PTA
cis-1,2-Dichloroethylene.....	GAC, PTA
trans-1,2-Dichloroethylene.....	GAC, PTA
o-Dichlorobenzene.....	GAC, PTA
2,4-D.....	GAC
Ethylene dibromide (EDB).....	GAC, PTA
Epichlorohydrin.....	PAP
Ethylbenzene.....	GAC, PTA
Heptachlor.....	GAC
Heptachlor Epoxide.....	GAC
Lindane.....	GAC
Methoxychlor.....	GAC
Monochlorobenzene.....	GAC, PTA
PCBs.....	GAC
Pentachlorophenol.....	GAC
Styrene.....	GAC, PTA
Tetrachloroethylene.....	GAC, PTA
Toluene.....	GAC, PTA
2,4,5-TP (Silvex).....	GAC
Toxaphene.....	GAC
Xylenes (o-, m-, p-).....	GAC, PTA

<sup>1</sup> Packed Tower Aeration (PTA); Granular Activated Carbon (GAC); Polymer Addition Practices (PAP). Source: EPA (9), 1986.

(1) *Granular Activated Carbon.* The use of GAC for drinking water treatment in the United States has been historically limited to addressing taste and odor problems. However, following the widespread detection of SOC's in drinking water supplies, research and many pilot-scale studies evaluating the effectiveness of GAC indicate that GAC can remove a broad spectrum of organic chemicals from water. Although GAC is considered to be the best available broad spectrum removal process, it exhibits a wide range of effectiveness in adsorbing organic compounds.

In general, the strongly adsorbed compounds consist of high molecular weight pesticides and insecticides with high boiling points, low solubilities, and consequently low carbon usage rates. Alachlor, heptachlor epoxide, lindane, and 2,4,5-TP (Silvex) are examples of compounds included in this category. In contrast, weakly adsorbed compounds are comprised of low molecular weight SOC's, which possess low boiling points, moderate solubilities, and therefore high carbon usage rates. Cis- and trans-1,2-dichloroethylene, and xylene, are examples of weakly adsorbed SOC's. Moderately adsorbed SOC's are pesticides, herbicides, and volatile organics which have physical and

chemical properties which lie between those of the strongly and weakly adsorbed compounds. Aldicarb, o-dichlorobenzene, and the VOC, tetrachloroethylene, all have intermediate carbon usage rates characteristic of this classification.

*GAC Operating Considerations:* The application of granular activated carbon adsorption for removing organic compounds from drinking water supplies involves the following major process design considerations:

- Carbon Usage Rate (CUR)—pounds of carbon per volume of water treated
- Empty Bed Contact Time (EBCT)
- Pretreatment
- Contactor Configuration—downflow versus upflow, pressure versus gravity, single-stage versus multi-stage or parallel versus series
- Method of GAC Regeneration—on-site versus off-site

*Carbon Usage Rate:* This basic design parameter, expressed as lbs/1,000 gallons, indicates the pounds of carbon required per 1,000 gallons of water treated—in this case to the level of the MCL. It indicates the rate at which carbon will be exhausted or replaced, thus affecting the operating cost of the treatment system. For full-scale GAC installation, the carbon usage rate is often the decisive factor in selecting on-site carbon regeneration or replacing spent carbon with virgin carbon. It also impacts any costs associated with carbon handling, such as storage, dewatering, losses via attrition, and transportation. A detailed discussion of each method is provided in the T&C document.

*Empty Bed Contact Time:* The empty bed contact time (EBCT), the volume of carbon divided by the hydraulic flow rate, provides an indication of the quantity of carbon which will be on-line at any one time, and thus reflects the capital cost for the system. The EBCT is an important design parameter as it has a significant impact on the carbon usage rate for each SOC. The carbon usage rate reflects the equilibrium capacity of GAC for a particular SOC, at a given influent concentration, if sufficient EBCT is provided.

*Pretreatment:* GAC systems may require some kind of pretreatment to prevent clogging of the carbon bed and to minimize the organic loading on the carbon. Clogging of the bed may be caused by suspended solids in the influent water or iron and manganese precipitation. Clogging is also caused by biological growth when the carbon bed life is long. However, systems should avoid chlorine disinfection prior to GAC adsorption because chlorine by-products

are adsorbed by the carbon and compete with the organics for adsorption sites. Also, if carbon regeneration is anticipated, adsorption of these chlorine by-products could result in the formation of additional hazardous substances during the regeneration processes. GAC systems are generally added to the end of a conventional treatment process which minimizes clogging.

When the background organic levels in the raw water are high, carbon is used at a faster rate, necessitating more frequent regeneration (or replacement). This increases the operating cost of the system. Pretreatment can reduce the organic loading on the carbon, thereby decreasing the carbon usage rate. The need for pretreatment should, however, be justified on the basis of costs. Examples of processes which may be used for pretreatment include conventional treatment, ozonation, and packed column aeration.

*Contactor Configuration:* The two basic modes of contactor operation are upflow and downflow. Upflow expanded bed contactors allow suspended solids to pass through the bed without producing a major drop in pressure. This configuration is not generally used in water treatment processes where the level of suspended solids is relatively low. Downflow fixed bed contactors offer the simplest and most common contactor configuration for SOC removal from drinking water. These contactors can be operated either under pressure or by gravity.

The choice of pressure or gravity is generally dependent upon the hydraulic constraints of a given system. Pressure contactors are more suitable to ground water systems because pumping of ground water is required. Gravity contactors are generally more suitable for surface water systems if sufficient head is available. Gravity contactors, when used, will typically be placed downstream of surface water filtration systems.

GAC contactors may be configured to operate in series or parallel. Parallel flow necessitates complete carbon replacement at SOC breakthrough; whereas, operation in series allows for utilization of the carbon in each contactor almost until exhaustion. In series, only the carbon in the first contactor is replaced when SOC breakthrough occurs. Although GAC is used more effectively in series, more contactors are required to treat the same quantity of water for the same EBCT.

*GAC Regeneration:* Another basic consideration in evaluating GAC system design for SOC removal is the method of



carbon regeneration. The two basic approaches to regenerating the carbon are off-site disposal or regeneration and on-site regeneration. Based on information from GAC manufacturers, on-site regeneration generally does not appear to be economical for systems where the carbon usage rate is less than 1,000 to 2,000 pounds per day.

**Treatability Studies:** Treatability studies were used to determine the feasibility of GAC to remove SOC from drinking water. These treatability studies are classified as isotherm evaluations, mini column tests, pilot-scale tests, and full-scale tests.

Isotherm evaluations are batch tests which yield the equilibrium or maximum SOC loading on a particular carbon at a given SOC equilibrium concentration. Isotherm data are used to develop model predictions to estimate carbon usage rates and bench-scale test design parameters. Bench scale tests use a mini column to estimate carbon usage rates under flowthrough conditions. Pilot tests are conducted with larger columns than those used in mini column testing and require significantly greater water quantities and longer run times. Full-scale tests evaluate the performance of GAC in actual field installations. In addition to the treatability studies, computer models can predict breakthrough profiles, carbon usage rates, and bed lives using treatability study results.

The Constant Pattern Homogeneous Surface Diffusion Model (CPHSDM) (Hand et al., 1984) was utilized to predict usage rates (Miltner et al., 1987). The model predictions were based on distilled water isotherm data.

However, since the background matrix has been shown to have an effect on the adsorption equilibria and kinetics (Summers, 1988; Crittenden, 1988), predicted carbon usage rates using distilled water isotherm data were compared with usage rates from actual field data using the following information:

- EBCT,
- Influent/effluent concentration, and
- Temperature.

The comparison of field and distilled water indicates that strongly adsorbable compounds are more affected by the presence of background matrix than weakly adsorbable compounds. The ratio of field to distilled water isotherm usage rates was calculated for each available influent/effluent combination. Based on the results, when the distilled water carbon usage rate (CUR) was less than 0.01 lbs/1,000 gallons, it was multiplied by 30 to give a corrected CUR. A multiplier of two was chosen

when the distilled water usage rate was greater than or equal to 0.01 lbs/1,000 gallons.

**GAC Design Criteria for Cost Model:** The following assumptions were used for design purposes:

- The contactors were sized to provide an empty bed contact time (EBCT) of 7.5 minutes at the design flow, and 15 minutes based on the average flow, except for the three largest flow categories.
- Systems with a design flow of less than 1 MGD used package pressure contactors; systems with a design flow of 1 MGD–11 MGD used pressure contactors; systems with a design flow larger than 11 MGD used concrete gravity contactors.
- Housing requirements assumed contactors were totally enclosed, with additional area for pipe galleries and operating and maintenance service area.
- Electrical energy was 25 Kwh/sq ft of building area per year.
- Maintenance material costs were estimated.
- Costs for land, raw water pumping, chlorination, bulk potable water storage, finished water pumping and waste disposal.

The base capital and O & M costs for carbon contactors are mainly flow dependent. However, the cost of replacing or regenerating the carbon must be evaluated at each site to determine its impact on the overall cost of the contactor.

The following assumptions were used for estimating the carbon replacement/regeneration costs:

- The raw water contained only the individual SOC under consideration.
- Carbon usage rates were developed using model predictions for the specific SOC in distilled water. These carbon usage rates were adjusted as follows: multiplied by 30, if the distilled water carbon usage rate was below 0.01 lbs/1,000 gallons and multiplied by two, if the distilled water carbon usage rate was greater or equal to 0.01 lbs/1,000 gallons.
- If the carbon demand (calculated based on carbon use rate and average flow) was less than 1,000 lb/day, the spent carbon was replaced at breakthrough.
- On-site regeneration utilized multiple-hearth furnaces oversized by 30 percent to account for downtime. For carbon demands greater than 80,000 lb/day, two or more furnaces were used. Carbon handling losses were assumed to be 15 percent.
- Cost of GAC was \$1/lb.

In order to determine the impact of carbon replacement/regeneration on the total cost, a relationship was developed between total production cost and carbon usage rate for each flow category. It shows that as the carbon usage rate drops, the costs drop. At a CUR of about 0.1 lbs/1,000 gallons, the cost curve flattens out. The family of cost curves (one for each size system) are parallel; i.e., higher costs for small systems versus lower costs for large ones. The curves are useful in that for any given system size, the costs for removal of an SOC to the MCL can be determined based on the CUR for that contaminant. SOC's with equivalent CURs will have equal removal costs. Where the cost curve flattens out at a CUR of 0.1, removal cost for that size system will be the same for all SOC's with a CUR below 0.1. Based on these observations, it is possible to provide costs for each size of treatment plant for SOC removal by grouping the SOC's together according to their carbon usage rates, and referring to the appropriate cost curve.

CURs for the moderate to high percent removals (i.e., 80–90% removals) down to the MCL were calculated for each SOC, and used to derive costs from the curves. These costs are presented in a following section in Table 27. The costs are expressed as total production costs (total capital plus operation and maintenance) in cents per 1,000 gallons. This is equivalent to dollars per average household per year (at 3.2 people using a total of 100,000 gallons per year).

The various studies reviewed indicate that all the SOC's proposed in the notice can be removed by GAC to levels at or below the MCLs at reasonable costs.

As discussed previously the cost of this technology is dependent on the carbon usage rate. Certain volatile organics and chlorinated aromatics have relatively poor adsorbabilities, which result in higher carbon usage rates. Because of their volatile nature, these SOC's may be removed more economically by packed tower aeration, which is discussed below.

(2) **Packed Tower Aeration.** The purpose of packed tower aeration (PTA) or packed column air stripping is to optimize conditions under which SOC's will transfer out of solution in water to solution in air. According to Henry's Law, the concentration of gas dissolving in a liquid at constant temperature and pressure is proportional to the partial pressure of the gas above the solution. If the equilibrium concentration of the gas above the liquid decreases, the tendency is for the gas dissolved in the liquid to transfer back to the gaseous phase.



Each SOC has a relative tendency to transfer, or partition, out of solution in water, and that tendency is quantified by a mass transfer coefficient. The mass transfer coefficient is a function of the design of the column and the chemical. The driving force for mass transfer is a change in the equilibrium which develops a concentration gradient. The mass transfer coefficient (MTC) relates the concentration gradient (driving force) with the actual quantity of material transferred from liquid to air. In packed columns, the packing material maximizes the surface area of water exposed to the air moving through the column. The air moving through the tower prevents equilibrium, and maintains the concentration gradient, forcing more gas out of solution into the air.

The greater the Henry's Law Coefficient (HLC), generally the more volatile the compound, and the less air required to remove the compound from the water. As a rule of thumb, SOC's having HLC's less than 1 atmosphere at or above room temperature, probably would not be effectively removed by packed tower aeration. In actual field conditions, the coefficient is approximately 50 percent of the value estimated from vapor pressure and solubility data at 20°C.

The compounds listed in Table 24 are potentially amenable to treatment via packed tower air stripping because of their high Henry's coefficients. The four compounds at the bottom of the list had a vapor pressure of less than 0.2 mm Hg, were not considered strippable, even if the Henry's coefficients were above 1 atmosphere. When the vapor pressure of a compound is very low, the solubility will drive the theoretical HLC up, while the strippability may in fact be low. The last four compounds listed in Table 24 may be strippable, but further testing would be required. Toxaphene and PCBs are mixtures which contain fractions which theoretically would be amenable to aeration.

TABLE 24.—SOCs AMENABLE TO AIR STRIPPING

Compounds	Henry's law coefficient (atm)
tetrachloroethylene	214.0
ethylbenzene	174.4
toluene	161.9
trans-1,2-dichloroethylene	149.5
p-xylene	149.5
m-xylene	137.0
o-xylene	124.5
cis-1,2-dichloroethylene	83.4
monochlorobenzene	74.7
heptachlor	73.1
styrene	62.4

TABLE 24.—SOCs AMENABLE TO AIR STRIPPING—Continued

Compounds	Henry's law coefficient (atm)
1,2-dichloropropane	53.5
o-dichlorobenzene	38.6
ethylene dibromide (EDB)	17.5
dibromochloropropane (DBCP)	7.0
toxaphene	2,010.0
heptachlor epoxide	24.4
PCB (Aroclor 1242)	39.3
chlordane	5.4

The design of air stripping equipment has been developed extensively in the chemical engineering industry for handling concentrated organic solutions. The rate at which a volatile compound is removed from water by aeration depends on the following factors: air-to-water ratio (ideally less than 100); packing material height; available area for mass transfer; water and air temperature; and the physical chemistry of the contaminant. The first three factors can be controlled in the design of the air stripping unit, while the last two (temperature and chemistry) are determined by the raw water quality.

The performance of packed column aeration systems in treating specific SOC's is dependent upon the mass transfer coefficient developed for each SOC. The MTCs can be estimated empirically from SOC physical/chemical properties and the physical characteristics of a particular packing material or they can be developed by actual pilot testing. The empirical approach allows cost estimating to be done on a consistent basis since pilot- and field-scale data often introduce a number of variables which are sometimes inconsistent between studies. The mass transfer coefficients developed by EPA were incorporated into a packed column design model to optimize the design criteria. The design criteria were then used in developing costs to determine the feasibility of PTA in removing individual SOC's from drinking water.

TABLE 25.—PACKED COLUMN DESIGN PARAMETERS

Ground water temperature	12 °C.
Column shell construction	304 stainless steel.
Packing material	1 inch plastic saddles.
Air well	concrete.
Maximum column diameter	16 ft.
Maximum liquid loading	30 gpm ft <sup>2</sup> .
Minimum air gradient	50 Nm-2m-1.
Safety factor for Henry's coefficient	1.1.

TABLE 25.—PACKED COLUMN DESIGN PARAMETERS—Continued

Safety factor for K <sub>1a</sub>	1.1.
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The transfer of VOC's from water to air by packed tower aeration (PTA) technology can pose a problem of exposure via inhalation of volatilized chemicals stripped from the water and transferred to the air.

EPA considered the risks posed by air stripping EDB and DBCP. EDB and DBCP are among the least volatile chemicals being considered using air stripping techniques. However, they are amenable to removal from water by using PTA. They are also probable carcinogens with unit risk factors (per  $\mu\text{g}/\text{m}^3$ ) of  $2.1 \times 10^{-4}$  (EDB) and  $6.7 \times 10^{-3}$  (DBCP). For comparison, the unit (per  $\mu\text{g}/\text{l}$ ) risk factors for oral ingestion is  $2.0 \times 10^{-3}$  (EDB), and  $4 \times 10^{-5}$  (DBCP).

To quantify the risk to downwind populations, EPA used a human exposure model (HEM) to perform a risk assessment. The HEM used data on emissions of EDB and DBCP from seven packed tower aeration facilities. It calculated individual risks and excess cancers of a population (based on 1980 census data) living for seventy years within a 50 km radius of the facility. The model assumes 100 percent transfer of the contaminant in the water to the air. It also assumes the PTA plants are located approximately in the middle of town, and that, for the purpose of air dispersion modeling, the terrain within 50 km is flat.

Because the HEM cannot factor in the risk of more than one chemical emission in the calculation, the risk factor for EDB, which poses a higher risk was used in the model. In order to use the EDB risk factor, the amount of all DBCP emissions was first divided by 3.2, the ratio of the DBCP and EDB risk factors, to account for the differences in carcinogenicity.

Table 26 compares the risks via inhalation of airborne EDB and DBCP emissions from air stripping facilities to the risks of drinking the EDB- and DBCP-contaminated water untreated. The maximum individual lifetime risk estimate is expressed as a probability. Thus, at  $3 \times 10^{-7}$ , the most exposed person has a risk of developing cancer of 3 in 10 million. This number can also be expressed by saying there would be three additional cancers if a population of 10 million were exposed to the maximum predicted concentration of the



contaminant throughout their (70-year) lifetimes.

It was apparent in the cases examined that the risk resulting from exposure to

EDB or DBCP by inhalation is several orders of magnitude lower than that resulting from drinking the contaminated water, and that the

amount of EDB or DBCP added to the air did not significantly increase risks from airborne contaminants.

TABLE 26.—INCREASED RISK DUE TO PTA TREATMENT

Location	Pollutant	Total population exposed	Total annual cancer incidence lifetime risk from exposure to air	Maximum individual lifetime risk from exposure to air	Maximum individual lifetime risk from exposure to water
A.....	DBCP.....	1,480,000	0.0001	$1 \times 10^{-7}$	$2 \times 10^{-4}$
B.....	EDB.....	401,000	<0.0001	$3 \times 10^{-7}$	$4 \times 10^{-3}$
C.....	EDB.....	437,000	<0.0001	$1 \times 10^{-7}$	$8 \times 10^{-3}$
D <sub>1</sub> .....	DBCP.....	658,000	<0.0001	$3 \times 10^{-6}$	$4 \times 10^{-3}$
D <sub>2</sub> .....	EDB.....	658,000	<0.0001	$1 \times 10^{-6}$	$3 \times 10^{-3}$
E.....	EDB.....	1,790,000	0.0001	$2 \times 10^{-6}$	$8 \times 10^{-3}$
F.....	DPCP.....	763,000	<0.0001	$3 \times 10^{-9}$	$3 \times 10^{-6}$
G.....	EDB.....	763,000	<0.0001	$6 \times 10^{-8}$	$3 \times 10^{-4}$

EPA proposes that in addition to GAC, PTA is also BAT for the twelve volatile contaminants listed in Table 27. PTA can remove SOC contaminants to levels at or below the MCLG, but because of the higher costs associated with EDB and DBCP removal, (compared to the removal of the other SOCs) EPA requests comments on whether PTA should be specified as BAT for these contaminants.

Where both carbon and aeration are effective in treating an SOC (i.e., a volatile SOC), both GAC and PTA are designated as BAT. The decision to use either technology depends on, among other things, the SOC, or combination of SOCs, the influent concentration, and the size of the system. For PTA, costs rise with increased percent removals needed to meet the MCL. For GAC, greater removals will only increase cost if the CUR becomes greater than 0.1 lb/

1,000 gallons. A volatile SOC with a low CUR may be cheaper to control using GAC than PTA if it has a strong affinity for carbon (a low CUR) and the influent concentration is high (high percent removal). For volatile SOCs with a low or medium CUR, total production costs using GAC may be lower than PTA for large systems, yet higher than PTA for smaller systems. The choice of GAC or PTA is also dependent on the design factors of each system.

TABLE 27. GAC AND PACKED COLUMN COSTS TO REMOVE SOCS

[Dollars/household/year]<sup>1</sup>

Compound	Carbon usage rate	GAC			PTA			Percent removal #
		Small	Medium	Large	Small	Medium	Large	
Volatile SOCs:								
cis-1,2-Dichloroethylene.....	0.544	\$650	\$52	\$14	\$110	\$8	\$5	65
Dibromochloropropane (DBCP).....	.089	600	39	8	310	51	36	90
o-Dichlorobenzene.....	.049	600	39	8	100	7	5	40
1,2-Dichloropropane.....	.134	600	42	10	180	15	11	95
Ethylbenzene.....	.093	600	39	8	93	6	4	30
Ethylene Dibromide (EDB).....	.068	600	39	8	210	23	16	90
Monochlorobenzene.....	.123	600	42	10	140	11	7	86
Styrene.....	.167	600	42	10	160	13	9	90
Tetrachloroethylene.....	.042	600	39	8	140	10	7	95
Toluene.....	.316	650	52	14	100	7	5	60
trans-1,2-Dichloroethylene.....	.497	650	52	14	130	9	6	86
Xylenes:								
m-Xylene.....	.153	600	42	10	120	8	6	76
o-Xylene.....	.450	650	52	14	120	8	6	76
p-Xylene.....	.496	650	52	14	120	8	6	76
Non-Volatile SOCs:								
Alachlor.....	.061	600	39	8	N/A			
Aldicarb (sulfoxide & sulfone).....	.033	600	39	8	N/A			
Atrazine.....	.134	600	42	10	N/A			
Carbofuran.....	.148	600	42	10	N/A			
Chlordane.....	.064	600	39	8	N/A			
2,4-D.....	.048	600	39	8	N/A			
Heptachlor.....	.140	600	42	10	N/A			
Heptachlor Epoxide.....	.032	600	39	8	N/A			
Lindane.....	.018	600	39	8	N/A			
Methoxychlor.....	.151	600	42	10	N/A			
PCBs.....	.021	600	39	8	N/A			
Pentachlorophenol.....	.024	600	39	8	N/A			
Toxaphene.....	.083	600	39	8	N/A			
2,4,5-TP (Silvex).....	.021	600	39	8	N/A			

<sup>1</sup> Costs include amortized capital and annual operation and maintenance. Reference: (9).

Small systems serve 25–100 persons; medium systems serve 10,000 to 25,000 persons; large systems serve greater than 1,000,000.

Cost in \$/household/year. Production in 1,000 gallons is equal to dollars per household per year (i.e., 8 ct./1,000 gallons=\$8.00/household per year).

<sup>2</sup> Percent removals from maximum influent levels to at or below the MCL.



EPA is requesting comment on the proposed BAT determination of packed tower aeration for the volatile SOCs; comment is especially requested on the treatability by PTA of EDB and DBCP.

c. *Proposed MCLs for Synthetic Organic Chemicals.* EPA established the proposed MCLs for the synthetic organic chemicals based upon an analysis of several factors. These include: (1) The effectiveness of BAT (either GAC or PTA) to reduce contaminant levels from influent concentrations to the MCLG. Since the two BATs are capable of reducing SOCs to extremely low levels, they are not the limiting factor determining the levels which are as close to the MCLG as feasible. (2) The feasibility (including costs) of applying BAT. EPA considered the availability of the technology and the costs of installation and operation for large systems (serving more than 1,000,000 people). (3) The performance of available analytical methods as

reflected in the PQL for each contaminant. In order to ensure that analytical measurement of contaminants at the MCL are sufficiently precise and accurate, the MCL is set at a level which is no lower than the PQL. (4) After taking into account the above factors, EPA then considered the risks at the MCL level for the EPA group A and B carcinogens to determine whether they would be adequately protective of public health. EPA considers a target risk range of  $10^{-4}$  to  $10^{-6}$  to be safe and protective of public health when calculated by the conservative linear multistage model. The factors EPA used in its analysis are summarized in Tables 28 and 29 for the non-carcinogenic and carcinogenic contaminants respectively.

(1) *Non-carcinogenic Contaminants.* For the non-carcinogenic contaminants listed in Table 28, each of the MCLs is proposed equal to their proposed MCLGs. Section 1412 of the SDWA requires EPA to set MCLs as close to the

MCLGs as is feasible (taking costs into consideration). EPA believes that it is feasible to set the MCLs at the MCLGs because: (1) The PQL for each contaminant is at or below the level established by the MCLG; (2) BAT can remove each contaminant to a level equal to or below the MCLG; and (3) the annual household costs to install BAT in large systems is a maximum of \$14.00 per household per year and generally less than \$10.00. EPA believes that these costs are affordable for large systems. Therefore, EPA proposes the MCLs for the non-carcinogenic contaminants equal to their MCLGs.

For styrene EPA is also proposing an MCLG of 0.1 mg/l based upon a Class C carcinogen classification. Based upon this classification the proposed MCL would also be 0.1 mg/l. EPA requests comments on the styrene classification and the MCL of 0.1 mg/l.

TABLE 28.—MCL ANALYSIS FOR SYNTHETIC ORGANIC CONTAMINANTS (NON-CARCINOGENS)

SOC contaminant	Proposed MCLG (mg/l)	Proposed MCL (mg/l)	PQL (mg/l)	Annual household costs using bat <sup>1</sup>	
				GAC	PTA
Aldicarb.....	0.01	0.01	0.005	\$8.00	
Aldicarb Sulfone.....	0.04	0.04	0.003	8.00	
Aldicarb Sulfoxide.....	0.01	0.01	0.008	8.00	
Atrazine.....	0.003	0.003	0.001	10.00	
Carbofuran.....	0.04	0.04	0.007	10.00	
o-Dichlorobenzene.....	0.6	0.6	0.005	8.00	\$5.00
cis-1,2-Dichloroethylene.....	0.07	0.07	0.005	14.00	5.00
trans-1,2-Dichloroethylene.....	0.1	0.1	0.005	14.00	6.00
2,4-D.....	0.07	0.07	0.005	8.00	
Ethylbenzene.....	0.7	0.7	0.005	8.00	4.00
Lindane.....	0.0002	0.0002	0.0002	8.00	
Methoxychlor.....	0.4	0.4	0.01	10.00	
Monochlorobenzene.....	0.1	0.1	0.005	10.00	7.00
Pentachlorophenol.....	0.2	0.2	0.0001	8.00	
Styrene.....	0.1	0.1	0.005	10.00	9.00
Toluene.....	2.0	2.0	0.005	14.00	5.00
1,3,5-TP (Silvex).....	0.05	0.05	0.002	8.00	
Xylene.....	10.0	10.0	0.005	14.00	6.00

<sup>1</sup> For large surface systems serving >1,000,000 people, see Table 27.

<sup>2</sup> For styrene EPA is also proposing an MCL of .005 based on a group B<sub>2</sub> classification. See table 29.

TABLE 29.—MCL ANALYSIS FOR SYNTHETIC ORGANIC CONTAMINANTS (CARCINOGENS) <sup>1</sup>

SOC contaminant	Proposed MCLG <sup>2</sup> (mg/l)	Proposed MCL (mg/l)	POL (mg/l)	Annual household costs using BAT <sup>4</sup>		10 <sup>4</sup> Risk Level (mg/l)	Notes
				GAC	PTA		
Alachlor.....	0	0.002	0.002	\$8.00	—	0.04	
Chlordane.....	0	0.002	0.002	8.00	—	0.003	
Dibromochloropropane (DBCP).....	0	0.0002	0.0002	8.00	\$36.00	0.002	
1,2-Dichloropropane.....	0	0.005	0.005	10.00	11.00	0.05	
Ethylene dibromide (EDB).....	0	0.00005	0.00005	8.00	16.00	0.00004	Proposed MCL is $1.25 \times 10^{-4}$ risk.
Heptachlor.....	0	0.0004	0.0004	10.00	—	0.0008	
Heptachlor epoxide.....	0	0.0002	0.0002	8.00	—	0.0004	
Polychlorinated biphenyls.....	0	0.0005	0.0005	8.00	—	0.0005	



TABLE 29.—MCL ANALYSIS FOR SYNTHETIC ORGANIC CONTAMINANTS (CARCINOGENS) <sup>1</sup>—Continued

SOC contaminant	Proposed MCLG <sup>2</sup> (mg/l)	Proposed MCL (mg/l)	PQL (mg/l)	Annual household costs using BAT <sup>4</sup>		10 <sup>-6</sup> Risk Level (mg/l)	Notes
				GAC	PTA		
Styrene <sup>5</sup>	0	0.005	0.005	10.00	9.00	0.1	Proposed MCL is $1.6 \times 10^{-4}$ risk.
Tetrachloroethylene	0	0.005	0.005	8.00	7.00	0.07	
Toxaphene	0	0.005	0.005	8.00	—	0.003	

<sup>1</sup> Classified by EPA as A or B carcinogens.<sup>2</sup> EPA policy is that for all A and B carcinogens the MCLG is zero.<sup>3</sup> Estimated.<sup>4</sup> For large surface systems serving > 1,000,000 people.<sup>5</sup> For styrene EPA is also proposing an MCL of 0.1 mg/l based upon a Group C classification. See table 28.

(2) *Carcinogenic Contaminants.* EPA considered the same factors in determining the proposed MCLs for carcinogenic contaminants as were used for the non-carcinogenic contaminants. However, the proposed MCLGs for carcinogens are zero, a level which by definition is not "feasible" because no analytical method is capable of determining whether a contaminant level is zero. The lowest level which can be reliably measured is the PQL. As described in section IV-A above, EPA calculated PQLs for most SOC's, at ten times the interlaboratory method detection limit. For toxaphene, EDB, and PCBs, EPA set the PQL at five times the interlaboratory method detection limit because the Agency believes that the carcinogenic risks posed by these three contaminants justify slightly less precision in measurement in order to obtain a more stringent level of control. EPA believes that setting the MCL equal to the PQL for each carcinogen contaminant is as close to the MCLG level as feasible.

EPA also calculated the per capita costs to remove the SOC contaminants to or below the MCL using GAC or PTA. These costs range from \$8.00 to \$36.00 per household per year. EPA believes these costs are reasonable and proposes the MCLs at the levels listed in Table 29.

Though EPA is proposing an MCL for pentachlorophenol at 0.2 mg/l based upon EPA's Group D carcinogen ranking, there is considerable evidence which could result in reclassification to Group B2. Based upon a B2 classification, the MCLG would be zero and the MCL would be set at the PQL of 0.0001 mg/l. EPA requests comment on this issue and whether an MCL of 0.0001 mg/l is feasible.

#### C. Treatment Technique for Acrylamide and Epichlorohydrin; Guidance for Styrene

The Agency evaluated the analytical methods to measure acrylamide, epichlorohydrin, and styrene drinking water concentrations. Currently

analytical methods do not exist which accurately measure, at any level, acrylamide and epichlorohydrin concentrations in drinking water. Thus, for these two contaminants, EPA believes that it is not technologically feasible to ascertain their level in drinking water. The SDWA authorizes EPA to promulgate a treatment technique in lieu of an MCL when analysis is not feasible. Consequently, EPA is proposing a treatment technique for both acrylamide and epichlorohydrin. EPA will continue to conduct research on analytical methods for these contaminants.

Although analytical methods exist to determine styrene in drinking water (described in section V), styrene may not be stable in all drinking waters since it appears to react with chlorine. Therefore, in addition to an MCL, EPA is providing guidance for public water systems using polymers containing styrene. EPA recommends that public water systems follow this guidance to minimize the amount of styrene which may enter the drinking water supply.

Acrylamide, epichlorohydrin, and styrene are introduced as impurities in water treatment chemicals and contact surfaces primarily during water treatment, storage and distribution. These chemicals are present in polymers and copolymers used as coagulant aids and ion exchange resins in water treatment processes and as grout and protective paints in the interior of water tanks and pipes. Polyacrylamide used as flocculant is extremely water soluble and is not expected to be removed during normal treatment. Styrene-divinylbenzene cross-linked copolymer, which is the basic resin material for ion exchange media, may contain residual styrene. The use of acrylamide, epichlorohydrin, and styrene polymers is widespread in drinking water systems and highly desirable because these materials are effective in removing other drinking water contaminants. Because a large segment of the U.S. population may be exposed to these substances,

EPA is proposing a treatment technique for acrylamide and epichlorohydrin to limit the exposure via drinking water.

Because no standardized analytical methods exist to determine acrylamide and epichlorohydrin in drinking water and accurate measurement of styrene may be complicated by styrene's decomposition in chlorinated water, EPA believes that limiting their introduction into drinking water via treatment appears to be the most effective means to reduce exposure to these contaminants.

In determining the proposed treatment techniques for acrylamide, epichlorohydrin and guidance procedures for styrene, EPA is relying upon information and data collected during operation of EPA's Drinking Water Additives Advisory Program. EPA formerly operated this program to provide technical assistance to concerned parties in evaluating drinking water additives products. Due to resource constraints, the Agency has decided to terminate this federal program and is seeking to help establish a program in the private sector. See 53 FR 25586 (July 7, 1988).

#### 1. Acrylamide

EPA proposes to control human exposure to acrylamide by limiting the level that may be used in products used during the treatment of drinking water. EPA is proposing that this level be based on the lowest level of the monomer which can be achieved by current manufacturing technology. EPA determined during operation of the Drinking Water Additives Advisory Program that the level of residual monomer in the polymer product can be reliably measured. This level is measured regularly by polymer manufacturers who certify such levels to EPA, utilities, and State authorities. Under the proposed rule, water systems must certify to the State that the amount of residual monomer in the polymer and



the dosage rate do not exceed specified levels.

Under the Drinking Water Additives Advisory Program, the maximum acceptable level of acrylamide in polyacrylamide was 0.05 percent. The maximum use level of polyacrylamide as a flocculant was 1 ppm. The acrylamide guidance level was adopted from the FDA regulations for polyacrylamide as a secondary direct food additive. This level of acrylamide is considered to be the lowest feasible level that can be achieved using available manufacturing practices. Therefore, the proposed treatment technique requires that PWSs not exceed these levels when acrylamide is used during water treatment.

EPA has estimated the possible exposure that might occur as a result of this treatment technique in order to assure that this approach adequately protects the public against the carcinogenic effects of acrylamide. EPA believes that using polyacrylamide as a flocculating agent is the major source of potential contamination of drinking water by acrylamide. Therefore, EPA has estimated that approximately 90 percent of acrylamide in water results from this use. The remaining 10 percent is estimated to be contributed from other sources, including quantities present in raw water and leaching from polyacrylamide containing adhesives, grouts and paints in contact with drinking water. If one makes the worst case assumption that all of the residual monomer remains in water during flocculation this yields a maximum of 0.0005 mg/l acrylamide in finished water. Taking into account exposure through leaching of polyacrylamide materials, total, human exposure to acrylamide via drinking water will at a maximum be, approximately 0.00055 mg/l.

EPA believes this estimate of the acrylamide in finished water is high because most of the acrylamide will hydrolyze or otherwise react to reduce the monomer level. However, the upperbound theoretical estimated excess cancer risk at the above concentration is  $5 \times 10^{-5}$  for a 70-kg adult who ingests 2 liters of drinking water per day over a 70-year lifetime. This estimate represents the upper 95 percent confidence limit from extrapolations prepared by EPA's Cancer Assessment Group using the linearized multistage model. This risk level falls within the  $10^{-4}$  to  $10^{-6}$  range generally considered by the Agency as acceptable.

Several analytical methods have recently been reported in the literature for the detection of acrylamide in

drinking water in the parts per billion range [see Daughton, C.G. 1988.

"Quantitation of Acrylamide (and Polyacrylamide): Critical Review of Methods for Trace Determination/Formulation Analysis and Future Research Recommendations"; Report prepared for the California Public Health Foundation, Berkeley, CA; and Letterman, Raymond D. and Pero, Richard W. 1988. "Polyelectrolyte Coagulants in Water Treatment as Assessment of Research Needs"; Report prepared for the AWWA Research Foundation, July 1988]. These methods have not been validated by EPA for analysis of drinking water samples and determinations of method detection limits (MDLs) and practical quantitation levels (PQLs).

EPA will study the usefulness of these methods for this regulation. If EPA determines that the method is technologically and economically feasible, the establishment of an MCL for acrylamide may be appropriate. If an MCL is established, the level would depend upon the feasibility of attainment, the detection limit, the PQL, cost and carcinogenic risk. At this time, these factors have not been determined. EPA anticipates that under an MCL, monitoring would be tied to system vulnerability based on the use of polyacrylamide. If EPA determines that it is feasible to establish an MCL for this contaminant, the Agency will solicit comment on a proposed MCL at that time. EPA requests comments on the alternative of establishing an MCL and the potential methodologies to analyze acrylamide in drinking water.

## 2. Epichlorohydrin

Several epichlorohydrin polymers and copolymers were accepted as flocculating agents by EPA's Drinking Water Additives Advisory Program. Epichlorohydrin polymers and copolymers are also used as contact surfaces for drinking water storage and distribution facilities. The most common residual epichlorohydrin concentration accepted in flocculating agents by EPA's Drinking Water Additives Advisory Program was 0.01 percent at a maximum usage rate of 20 ppm, though some flocculating agents were accepted at lower levels. EPA proposes that the maximum residual epichlorohydrin content concentration in flocculating agents shall not exceed .01 percent at a maximum usage rate of 20 ppm.

To evaluate the possible health effects associated with the .01 percent level, EPA conservatively assumed that all the residual epichlorohydrin monomer remains following flocculation. This results in an epichlorohydrin

concentration in treated water of 0.002 mg/l. If one assumes, as was assumed with regard to acrylamide, that 10 percent of the total epichlorohydrin in drinking water is introduced from indirect sources (leaching from contact surfaces) and the remaining 90 percent is derived from epichlorohydrin-containing flocculating agents, the nominal epichlorohydrin concentration in drinking water would be 0.0022 mg/l. At 0.0022 mg/l the upper bound hypothetical cancer risk calculated using the multistage model (95 percent upper confidence limit) for a 70-kg adult consuming 2 liters of water per day over a 70-year lifetime would be  $6 \times 10^{-7}$  (EPA/CAG).

The regulations for epichlorohydrin in drinking water are based upon limitations on conditions of use of epichlorohydrin-based polymers as part of a treatment technique and polymer quality specifications based upon available manufacturing technology.

Epichlorohydrin-based polymers employed as indirect additives in drinking water must contain no more than 0.01 percent residual epichlorohydrin, assuming a maximum dose of 20 ppm of polymer. The Food and Drug Administration (FDA) has established residual levels of .001 percent for certain food additive applications (21 CFR 173.60). EPA requests comments concerning whether FDA's food additive limitations are relevant to the Agency's proposed standard for epichlorohydrin-based drinking water applications.

Based upon information available to date, EPA believes the 0.01 percent level represents the lowest feasible attainable level since products containing 0.01 percent epichlorohydrin are widely available at no incremental cost to public water systems. If products with less epichlorohydrin are available, systems may use them. However, given the extremely low risks of the 0.01 percent level proposed by EPA, lower residual levels would offer negligible improvements to public health. In addition, such products may be more costly for public water systems.

## 3. Styrene

EPA proposes an MCL of 0.005 mg/l and 0.1 mg/l for styrene (see Section V of this proposal). However, EPA recognizes that measurement of styrene may be problematic in certain instances. EPA believes that recommending a guidance level for styrene in styrene copolymers used as additives can reduce further styrene exposure via drinking water. EPA's Drinking Water Additives Advisory Program



recommended several styrene copolymers as secondary direct additives (e.g., as ion exchange resins, coagulant aids, etc.). Among styrene copolymers, the lowest styrene residual monomer concentration is 0.09 ppm at a recommended dose of 20 mg/l. Assuming that all the residual styrene associated with the polymer remains in water, this would result in a styrene concentration of 0.000002 mg/l.

Because EPA's Drinking Water Additives Advisory Program data base on the range of residual styrene concentrations in styrene copolymers was somewhat limited, the technology to produce styrene copolymers at 0.09 ppm may not be commonly available for use by PWSs throughout the United States. Consequently, a ten-fold upward adjustment for the minimum residual concentration (i.e., 0.9 ppm), was used to account for this uncertainty. At this residual concentration and an application rate of 20 mg/l the concentration in water under worst case conditions would be 0.00002 mg/l. This concentration level is still significantly lower than the proposed MCLs for styrene.

EPA recommends that styrene copolymers intended for use as ion-exchange resins follow additional use restrictions: (1) The resin bed should be thoroughly cleaned by washing with a minimum of five bed volumes of water prior to distributing water to consumers; (2) the rinse water should be discarded; (3) the temperature of the water passing through the resin bed should be maintained at 25 °C or less; and (4) the flow rate of the water passing through the bed should be more than 2 gallons/cubic ft/minute. These use conditions are adapted from FDA regulations governing the use of polymeric styrene-divinylbenzene ion exchange resins for treatment of bulk quantities of aqueous food and water (21 CFR 173.25).

#### 4. Summary

The approaches described above for controlling acrylamide, epichlorohydrin, and styrene occurrence in drinking water are based on the lowest monomer level which is achievable with current manufacturing technology. These levels were determined by EPA through its experience with the Drinking Water Additive Advisory Program. The resulting monomer levels in polymeric drinking water additives are 0.0005 mg/l for acrylamide and 0.002 mg/l for epichlorohydrin. 0.00002 mg/l is also recommended as the monomer level when styrene is used as an additive. Compliance for acrylamide and epichlorohydrin will be determined by water systems certifying to the State

that the combination of dose and monomer level in the product do not exceed these specified monomer levels. Similarly, a recommended treatment technique for styrene is provided in this notice in addition to the MCL.

Each public water system must annually certify to the State that it achieves the specified levels by not exceeding the specified dosage levels. For acrylamide, the public water system may not exceed 0.05 percent acrylamide in polyacrylamide dosed at 1 ppm. For epichlorohydrin, the public water system may not exceed 0.01 percent residual epichlorohydrin concentration dosed at 20 ppm. For styrene, EPA recommends that public water systems not exceed 1 ppm in styrene copolymers used as direct additives and as resins. Public comments are requested on the treatment control approach described above for acrylamide, epichlorohydrin and the guidance for controlling styrene.

### V. Variances and Exemptions

#### A. Variances

Under section 1415(a)(1)(A) of the SDWA, EPA or a State which has primary enforcement responsibility (i.e., primacy) may grant variances from MCLs to those public water systems that cannot comply with the MCLs because of characteristics of the water sources that are reasonably available. A variance may only be granted to those systems which have installed BAT as identified by EPA pursuant to section 1415. Though EPA is not proposing that BATs meet specified performance criteria, EPA solicits comments on this issue. EPA at the time of final promulgation of this rule may specify minimum performance criteria before a variance is issued.

Furthermore, before EPA or a State may grant a variance, it must find that the variance will not result in an unreasonable risk to health. The levels representing an unreasonable risk to health for each of the contaminants in this proposal will be addressed in a subsequent Federal Register notice. In general, the unreasonable risk to health level would reflect acute and subchronic toxicity for short-term exposures and high carcinogenic risks for long-term exposures (as calculated using the linearized multistage model in accordance with the Agency's risk assessment guidelines).

Under section 1413(a)(4), States that choose to issue variances must do so under conditions, and in a manner, which are no less stringent than EPA allows in section 1415. States may adopt standards which are more stringent than the EPA standards.

EPA specifies BATs for variance purposes. EPA may vary its BAT findings under section 1415 for variances from its BAT findings under section 1412 for MCLs depending on a number of factors, including system size, physical conditions related to engineering feasibility, and MCL compliance costs.

#### 1. Best Available Technology for Inorganic Compounds

Table 30 shows the BATs that EPA is proposing for variance purposes for inorganic compounds. EPA has not proposed coagulation/filtration or lime softening as BAT for small systems (i.e., those systems  $\geq 500$  connections) for the purpose of granting variances because they are not technologically feasible for small systems, as noted below.

Coagulation/filtration and lime softening of the heavy metals (i.e., barium, cadmium, chromium, mercury and selenium) are more complex than conventional treatment (i.e., treatment for turbidity removal). Their complexity results in the need for increased operating time and expertise to operate coagulation/filtration and lime softening systems. This complexity is a result of: (a) Generally higher pH requirements for precipitation of heavy metals than for turbidity; (b) differences in coagulant selection, generally favoring the iron salts; (c) much higher doses of coagulants or lime to precipitate heavy metals than for conventional turbidity removal or lime softening; and (d) larger sedimentation basins and possible two-stage processes (one for turbidity softening and one for metals precipitation). Consequently, EPA believes coagulation/filtration and lime softening are too complex, as measured by operating time and the level of expertise required, for small systems.

Costs of installing and operating reverse osmosis, activated alumina, and ion exchange are relatively high for small systems compared to large systems. EPA requests comment on whether these technologies should constitute BAT for small systems under section 1415. EPA is continuing to evaluate what costs are reasonable for public water systems. Commenters are encouraged to provide comment on what should constitute BAT for small systems. The Agency is currently developing affordability criteria and will request public comment on those criteria in a separate notice. After public comment the Agency may use them in this rulemaking.

With regard to BAT under section 1415, EPA requests comment on: (1) Whether other technologies should be considered BAT under section 1415 for



the IOCs; (2) whether it is appropriate to exclude coagulation/filtration and lime softening for small systems; and (3) the appropriateness of reverse osmosis

(RO), ion exchange and activated alumina as BAT under section 1415 for small systems. EPA notes that RO offers the benefit of multiple contaminant

removal and desalting, which makes RO technology especially attractive for some drinking water systems, including small systems.

TABLE 30.—BAT FOR IOCs FOR VARIANCES

Inorganic contaminant	Best available technologies							
	Activated alumina	Coagulation/filtration <sup>1</sup>	Corrosion control	Direct & diatomite filtration	Granular activated carbon	Ion exchange	Lime softening <sup>1</sup>	Reverse osmosis
Asbestos.....		X	X	X				
Barium.....						X	X	X
Cadmium.....		X	X			X	X	X
Chromium III.....		X				X	X	X
Chromium VI.....		X				X		X
Mercury.....		X <sup>2</sup>			X		X <sup>2</sup>	X <sup>2</sup>
Nitrate and nitrite.....						X		X
Selenium IV (selenite).....	X	X					X	X
Selenium VI (selenate).....	X						X	X

<sup>1</sup> Not BAT for systems less than 500 service connections.

<sup>2</sup> BAT only if influent mercury concentrations do not exceed 10 ug/l. Coagulation/Filtration for mercury removal includes PAC addition or post-filtration GAC column where high organic mercury is present in source water.

## 2. Best Available Technology for Synthetic Organic Chemicals

EPA proposes granular activated carbon as BAT for SOC under section 1415 for all size systems (see Table 23). PTA is proposed as BAT for the volatile SOC and EDB and DBCP. EPA believes these technologies, as discussed in Section IV, are technologically and economically feasible for all size systems.

EPA, however, specifically requests comment on whether PTA should be BAT under section 1415 for DBCP and EDB in light of the fact that air to water ratios of greater than 100 would be required for 90 to 99 percent removal, resulting in increased costs.

## 3. Use of POU Devices and Bottled Water

Under section 1415(a)(1)(A)(ii) of the Act, when the State grants a variance, it must prescribe an implementation schedule of any additional required control measures. The State may require the use of POU devices, bottled water, or other mitigating measures as "additional control measures" as a condition if an unreasonable risk to health exists. EPA has previously promulgated regulations specifying when POU devices and bottled water may be used. (See 52 FR 25690, 25701-25702, and 25708, July 8, 1987.) This proposed rule would extend those provisions to cover the contaminants in this notice. EPA's explanation for those provisions was explained in the July 8, 1987 rulemaking.

### B. Exemptions

Under section 1416(a), a State or EPA may grant an exemption extending

deadlines for compliance with a treatment technique or MCL if it finds that (1) due to compelling factors (which may include economic factors), the PWS is unable to comply with the requirement; (2) the exemption will not result in an unreasonable risk to human health; and (3) the system was in operation on the effective date of the NPDWR, or, for a system not in operation on that date, that no reasonable alternative source of drinking water is available to the new system.

If EPA or a State grants an exemption it must at the same time prescribe a compliance schedule (including increments of progress) and it may specify appropriate control measures that the system must meet while the exemption is effective. Under section 1416(2)(A), the schedule must require compliance within one year after issuance of the exemption. However, section 1416(b)(2)(B) states that EPA or the State may extend the final compliance date for a period not to exceed three years, if the public water system is taking all practicable steps to comply and one of the following conditions applies: (1) The system cannot comply without capital improvements which cannot be completed within the period of the exemption; (2) in the case of a system which needs financial assistance for the necessary implementation, the system has entered into an agreement to obtain financial assistance; or (3) the system has entered into an enforceable agreement to become part of a regional public water system. For public water systems which serve less than 500 service connections and which need

financial assistance for the necessary improvements, EPA or the State may renew an exemption for one or more additional two-year periods if the system establishes that it is taking all practicable steps to meet the requirements noted above.

Under section 1416(d), EPA is required to review State-issued exemptions at least every three years and, if the Administrator finds that a State has, in a substantial number of instances, abused its discretion in granting exemptions or failed to prescribe schedules in accordance with the statute, the Administrator, after following established procedures, may revoke or modify those exemptions and schedules. EPA will use these procedures to scrutinize exemptions granted by States and, if appropriate, may revoke or modify exemptions.

As a condition for receiving an exemption, the State may require the use of POU devices or bottled water for the duration of the exemption. The exemption conditions are the same as those referenced in the variance section.

## VI. Compliance Monitoring Requirements

### A. Background

Compliance monitoring requirements are proposed to determine whether community (CWS) and non-transient, non-community water systems and transient non-community water systems (for nitrate/nitrite only) supply drinking water that meets the MCLs. EPA is proposing these monitoring requirements under section 1445 of the SDWA.



Although section 1412(b) of the SDWA provides that the National Primary Drinking Water Regulations (as described in section 1401) take effect 18 months after their promulgation, under section 1445 there is no such limitation for monitoring, reporting, and recordkeeping regulations. To allow the monitoring requirements to be effective within 30 days of promulgation, EPA proposes to promulgate these regulations under section 1445. Effective 18 months after promulgation, the monitoring requirements will also be deemed to be promulgated under section 1412. This change will allow systems to complete monitoring and analysis by the effective date of the MCLs (effective date of the MCLs are 18 months after promulgation of this regulation). Each contaminant in this proposed rule is classified using the three-tiered approach (presented in the Advanced Notice of Proposed Rulemaking published on October 5, 1983, 48 FR 45502). The tiers are as follows:

**Tier I**—Those contaminants which occur with sufficient frequency, are of sufficient concern to warrant national regulation (MCLs), and therefore require uniform monitoring and reporting (M/R) requirements.

**Tier II**—Those contaminants which occur with limited frequency, are of sufficient concern to warrant national regulation (MCLs), and therefore justify flexible monitoring requirements based on vulnerability assessments.

**Tier III**—Those contaminants which occur with limited frequency and are not of sufficient concern to warrant development of a national regulation (MCL), but for which EPA may provide non-regulatory health guidance to States and water systems.

The main difference between Tier I and II contaminants is the probability and predictability of occurrence, although the health implications of contaminants in the two groups may be similar. The three-tiered approach was developed to provide a framework for developing both MCL and monitoring requirements based on the health significance of the contaminants in drinking water, the occurrence, and the predictability of occurrence or potential occurrence.

EPA proposes to classify all inorganic contaminants in this proposal as Tier II contaminants except nitrate and nitrite, which are classified as Tier I contaminants. This proposed classification is based in part on the recommendations from a Workshop on Revised Drinking Water Regulations for Inorganics and Corrosion By-products held on June 4-6, 1985. The results from this workshop are summarized in the

Methods and Monitoring Document for Inorganic Contaminants.

Nitrate and nitrite are proposed as Tier I contaminants because the presence of nitrates is widespread in drinking water supplies and their presence is associated with acute adverse health effects in infants. In addition, nitrate/nitrite occurrence is expected to continue due to the widespread use of fertilizers.

All the SOC's are proposed as Tier II contaminants. Tier II includes those contaminants whose occurrence may be predictable in drinking water based upon a multiplicity of factors such as geological conditions, use patterns (e.g., pesticides), type of source, historic record, or the nature of the distribution system. Tier II contaminants appear to warrant giving States discretion so that monitoring requirements are tailored to local conditions. Thus, although compliance with the MCL is required in all cases, EPA is providing States the latitude to tailor monitoring requirements for each system provided the minimum Federal standards are met.

EPA has divided the SOC's into two groups to propose monitoring requirements:

**Group A—Ten Volatile Synthetic Organic Chemicals (VOCs)**

cis-1,2-Dichloroethylene	Toluene.
1,2-Dichloropropane	trans-1,2-Dichloroethylene
o-Dichlorobenzene	Xylenes (total)
Ethylbenzene	Tetrachloroethylene
Monochlorobenzene	Styrene.

**Group B—SOCs: Eighteen Pesticides and Polychlorinated Biphenyls (PCBs)**

Alachlor	Ethylene dibromide (EDB).
Aldicarb	Heptachlor
Aldicarb sulfone	Heptachlor Epoxide
Aldicarb sulfoxide	Lindane
Atrazine	Methoxychlor
Carbofuran	Polychlorinated biphenyls (PCBs)
Chlordane	Pentachlorophenol
Dibromochloropropane (DBCP)	Toxaphene
2,4-D	2,4,5-TP (Silvex).

EPA has separated the SOC's into two groups for three reasons. First, the sources and mechanisms of contamination of drinking water are different for Groups A and B. VOCs are most likely to occur in areas with considerable industrial activity, while pesticides are most likely to occur in areas with considerable agricultural activity. Second, the available occurrence data indicate that the presence of VOCs is more widespread

throughout the U.S. than the presence of pesticides. Therefore pesticide monitoring can be targeted based on knowledge of pesticide use and cropping patterns. Third, the same analytical methods are used to monitor all the VOCs in Group A, while different techniques are needed to monitor the pesticides and PCBs in Group B.

In developing the proposed compliance monitoring requirements for these contaminants, EPA considered:

(1) The likely source of drinking water contamination, (2) differences between ground and surface water systems, (3) samples which are representative of consumer exposure, (4) sample collection and analysis costs, (5) use of historical monitoring data which identifies vulnerable systems and subsequently specifies monitoring requirements for vulnerable systems, (6) the limited occurrence of some contaminants, and (7) the need for States to tailor monitoring requirements to system-specific conditions.

Monitoring requirements for surface and ground water systems are addressed separately because: (1) The sources and mechanisms of contamination for ground and surface water systems are different, (2) the overall quality of surface waters tends to change more rapidly with time than does the quality of ground waters, (3) seasonal variations tend to affect surface waters more than ground waters, and (4) spatial variations are more important in ground waters than in surface waters since groundwater contamination is often a localized problem confined to one or several wells within a system. Therefore, monitoring frequency is an important factor for surface water systems while sampling location is important for groundwater systems. The proposed monitoring requirements require surface water systems to monitor more frequently than groundwater systems.

EPA desires monitoring requirements which ensure the statutory goal of compliance with the MCLs and efficiently utilize State and utility resources. A major goal is to ensure these monitoring requirements are consistent with monitoring requirements promulgated previously by EPA. The monitoring program proposed by EPA focuses monitoring in individual public water systems to the contaminants that are likely to occur. This approach includes:

- For the volatile SOC's listed in § 141.61(a), allowing States to reduce monitoring frequencies based upon a vulnerability assessment. For the pesticides and PCBs listed in § 141.61(c),



requiring only vulnerable systems to monitor.

- Allowing States to target monitoring to those systems which are vulnerable to a particular contaminant.

- Allowing the use of recent monitoring data in lieu of new data if the system has conducted a monitoring program using reliable analytical methods.

- Encouraging the States to use historical monitoring data meeting specified quality requirements and other available records to make decisions regarding a system's vulnerability.

- Requiring all vulnerable systems to conduct repeat monitoring unless the system demonstrates that its vulnerability status has changed.

- Designating sampling locations and frequencies that permit simultaneous monitoring for all regulated contaminants, whenever possible.

- Requiring that samples be taken during high vulnerability times for those contaminants whose concentration may fluctuate seasonally (e.g., nitrates, pesticides).

#### *B. Rounding of Analytical Results for Compliance Determination*

The procedure to be followed in determining compliance with the revised regulations for both the inorganic and organic chemicals is as follows: Data reported to the State or EPA should contain the same number of significant digits as the MCL. In calculating data for compliance purposes, numbers should be rounded off to one significant digit. The last significant digit should be increased by one unit if the digit dropped is 5, 6, 7, 8, or 9. If the digit is 0, 1, 2, 3, or 4, the preceding number does not change. For example, analytical results for mercury of 0.0016 mg/l would be reported as 0.002 mg/l, while results of 0.23 mg/l for pentachlorophenol would be reported as 0.2 mg/l. For nitrate, results of 10.4 mg/l would be rounded to 10 mg/l, while a value of 10.6 mg/l would be rounded to 11 mg/l and would be in violation of the MCL.

#### *C. Inorganic Chemical Monitoring Requirements*

##### **1. Introduction**

EPA proposes to change the existing monitoring requirements for barium, cadmium, chromium, mercury, nitrate, and selenium and proposes new monitoring requirements for asbestos and nitrite. In addition, EPA proposes to reorganize the current fluoride monitoring requirements in § 141.23(g) and include fluoride in the monitoring requirements applicable to barium, cadmium, etc. Including fluoride in the

requirements applicable to the other inorganics is not a substantive change from existing requirements and serves to simplify the inorganic monitoring requirements.

EPA believes that the inorganic contaminant sampling and analytical costs are reasonable and that sufficient analytical capability currently exists to analyze all inorganic contaminants except asbestos (see the discussion under the Analytical Methods, Section IV-A). To provide enough time for laboratory capabilities to expand, EPA is proposing that water supply systems be allowed to complete the first round of monitoring requirements for asbestos within five years of publication of the final rule.

##### **2. Dates for Completion of Initial Monitoring**

The new MCLs being promulgated under section 1412 of the Act (see proposed § 141.62), will not become effective until 18 months after promulgation. Prior to that time the existing MCLs (see § 141.11) will remain in effect.

Effective thirty days after promulgation, the monitoring requirements contained in the final rule will replace existing monitoring provisions contained in 40 CFR 141.23. Proposed § 141.23 notes that the new monitoring requirements for inorganics will apply to both the existing MCLs and the new MCLs being promulgated by EPA "as appropriate." This provision means that the new monitoring requirements must be followed in determining compliance with the existing MCLs until those MCLs are superseded by the new MCLs being promulgated at § 141.62. EPA believes it is appropriate to require systems to follow the new monitoring requirements in determining compliance with existing MCLs for several reasons. First, the new monitoring provisions are not significantly different from the current monitoring protocols being followed by water systems, and changing to the new procedures should therefore not be difficult. Second, since systems will have to complete monitoring for the new MCLs within 18 months in any case, applying the new monitoring provisions for the existing MCLs will eliminate the need for duplicative monitoring to determine compliance with the existing and new MCLs.

Under this proposal community water systems are required to complete the initial round of monitoring for barium, cadmium, chromium, nitrate, nitrite, mercury and selenium and report the results to the State within 18 months of promulgation; non-transient, non-

community water systems must complete the initial round of monitoring and report the results to the State within four years of promulgation. Since virtually all non-transient, non-community water systems are small systems serving less than 3,300 persons, this proposal is consistent with previous EPA proposals to phase in monitoring requirements based on system size. For asbestos, both community and non-transient, non-community systems that are vulnerable to asbestos contamination must complete all monitoring and report the results to the State within five years of promulgation.

EPA requests comments on allowing non-transient, non-community systems four years to complete inorganics monitoring and five years for community and non-transient, non-community water systems to complete the asbestos monitoring. Comment is particularly requested on whether non-transient, non-community water systems should have up to four years to complete the initial sampling for nitrate/nitrite or whether these systems should complete that sampling sooner.

##### **3. Sampling Location**

Under the proposed regulation, surface water systems must sample at points in the distribution system which are representative of each source or at each entry point to the distribution system which is located after any treatment and which is representative of each source. The number of samples will be determined by the number of sources or treatment plants. For groundwater systems, sampling must be done at each entry point to the distribution system after treatment. The number of samples a system must take will be determined by the number of entry points. EPA believes this approach will make it easier to pinpoint possible contaminated sources (wells) within a system. In both surface and ground water systems, the proposed sampling locations are such that the same sampling locations may be used for the collection of samples for other source-related contaminants such as the volatile organic chemicals, which simplifies sample collection efforts. The only exception would be for asbestos, where if the system has asbestos/cement (A/C) pipes, sampling must be at a tap served by asbestos cement pipe. Inorganic sampling (except for nitrate/nitrite) may be conducted at any time. Nitrate/nitrite sampling must be conducted at the time when the system is most susceptible to contamination. This generally occurs after rain and after the application of fertilizers when there may be fertilizer runoff. EPA is



proposing nitrate sampling at the time the system is most vulnerable to ensure that monitoring detects contamination when it is most likely to occur.

This proposed rule relates primarily to contaminants that enter drinking water due to contamination of source waters. However, in some cases contamination may occur as a by-product of corrosion in the water delivery system. EPA has proposed monitoring requirements for corrosion by-products (i.e., lead and copper) in another rule. Monitoring for such corrosion by-products generally occurs at the tap in order to ensure that contamination due to corrosion is detected. Two contaminants addressed by this proposal are potential corrosion by-products: cadmium and asbestos.

Cadmium present in some galvanized iron pipes in the distribution system has the potential to leach into the drinking water. Present evidence indicates that the cadmium contribution from galvanized iron pipes is insignificant. EPA therefore believes that cadmium exposure from drinking water primarily results from cadmium in the source water. Therefore, cadmium monitoring requirements in the proposed rule are designed to detect source-related contamination.

Asbestos may also be present at the tap (in addition to in the source) due to corrosion of A/C pipe that is used in some distribution systems. Where the potential exists for asbestos contamination due to corrosion, EPA proposes that sampling be conducted at the tap. The proposed monitoring requirements for asbestos are explained in more detail below.

Public comments are requested on the proposed requirements related to monitoring locations.

#### 4. Monitoring Frequency

*Barium, cadmium, chromium, mercury, and selenium:* Under this proposal, groundwater systems must monitor every three years and surface water systems must monitor annually. The State may reduce the three year and one year monitoring frequencies to no less than every ten years provided: (1) Surface systems have monitored annually for at least three years and groundwater systems have conducted at least three rounds of monitoring; and (2) all previous analytical results are <50 percent of the MCL. Systems using a new water source are not eligible for reduced monitoring until three rounds of monitoring from the new source are completed. States should base their decision on the reduced monitoring frequency for each system on consideration of historical analytical results, variations in the historical

results, and system changes such as pumping rates or stream flows/characteristics.

EPA is proposing to allow States to reduce the inorganic monitoring frequencies where an adequate baseline of data has been collected because EPA believes that drinking water contamination by most IOCs is highly stable over time. Therefore, those systems that can demonstrate to the State that there is a remote possibility that the system will exceed the MCL can be allowed to monitor on a less frequent basis.

*Asbestos:* Systems determined by the State to be vulnerable to asbestos contamination after a vulnerability assessment are required to complete one round of monitoring within 5 years of promulgation of the final rule. If the asbestos concentration in the initial round is  $\geq 50$  percent of the MCL, then groundwater systems must monitor every three years and surface water systems must monitor annually. If the initial results are <50 percent of the MCL, then the State can determine the repeat monitoring frequency. EPA believes it is appropriate to base the repeat monitoring frequency on the analytical results of the initial monitoring because it believes that the possibility of the system exceeding the MCL in the future is remote where the initial results are <50 percent of the MCL. Consequently, repeat monitoring in cases where the result is <50 percent of the MCL would not be required by the rule. Public comment is requested on this approach.

*Nitrate and Nitrite—Community and Non-Transient, Non-Community Water Systems:* Under the proposed rule, groundwater systems must monitor annually for nitrate and nitrite. Groundwater systems must however, monitor quarterly when the concentration is  $\geq 50$  percent of the MCL(s) for any one sample. The sampling frequency must remain quarterly until four consecutive quarterly samples are <50 percent of the MCL(s). Surface water systems must monitor quarterly. Surface water systems may sample annually provided all analytic results from four consecutive quarters are <50 percent of the MCL(s). Surface water systems must return to quarterly monitoring if any one sample is  $\geq 50$  percent of the MCL(s).

*Nitrate and Nitrite—Transient, Non-Community Water Systems:* EPA is proposing to change the current nitrate monitoring requirements for transient, non-community water systems from monitoring at the discretion of the State to a minimum of every three years for groundwater systems and annually for

surface water systems for both nitrate and nitrite. EPA believes this change for transient, non-community water systems is appropriate due to the widespread presence of these contaminants in drinking water and because they are associated with acute health effects in infants. EPA requests comments on the proposed monitoring frequencies for nitrate and nitrite for transient, non-community water systems and whether the frequencies are adequate to protect customers in such systems.

#### 5. Confirmation Samples

*Asbestos, barium, cadmium, chromium, mercury, selenium:* If an analytical result indicates that the contaminant level in a system exceeds the MCL, the proposed rule provides that the State may require the system to take a confirmation sample. The confirmation sample must be taken within two weeks after the system is notified of the analytical result and must be taken at the same sampling point as the original sample.

*Nitrate and Nitrite:* If an analytical result indicates the system will exceed the MCL, then the proposed rule provides that the system must take a confirmation sample within 24 hours of notification of the analytical result from the first sample. Results of both samples must be reported to the State within two weeks of the date the initial sample was taken.

#### 6. Compliance Determination

For systems which are monitoring quarterly, compliance with the MCLs for asbestos, barium, cadmium, chromium, mercury, and selenium is determined by a running annual average (i.e., the last four quarterly samples) at each sampling point. If any one quarterly sample would cause the annual average to be exceeded, the system is out of compliance immediately. For example, if the first quarterly sample were four times the MCL, the system would be out of compliance based on that one sample. This provision serves to provide early notification to consumers of potential health risks. If the average exceeds the MCL at any sampling point, then the entire system is out of compliance and public notification is required. For systems which are monitoring annually or less frequently, a system is out of compliance with the MCLs for asbestos, barium, cadmium, chromium, mercury, and selenium if the analytical result at any sampling point exceeds the MCL. If a confirmation sample is required by the State, then the average of two samples is used. Compliance for nitrate and nitrite is based on one sample or, if the



initial sample exceeds the MCL, on the average of two samples (i.e., initial and confirmation).

#### 7. Asbestos Monitoring

Asbestos occurs in drinking water as a result of asbestos in the raw water supply and/or as a result of corrosion of asbestos-cement pipe in the distribution system. Therefore, systems must first determine whether asbestos may be a source-related problem and/or a distribution system problem before the appropriate monitoring regime is established. Because of the analytical limitations (e.g., analytical costs, limited trained personnel and laboratory capabilities) described above, EPA proposes that only vulnerable systems must monitor for asbestos. States are required to evaluate a system's vulnerability to asbestos contamination within 18 months of rule promulgation. The assessment must consider the following factors: (1) Potential contamination of the water source and (2) the use of asbestos-cement pipes for finished water distribution and the corrosive nature of the water.

In evaluating whether systems may be vulnerable to asbestos contamination due to corrosion of A/C pipe, States should consider systems to be vulnerable that have A/C pipe as well as aggressive water. The aggressivity of water is measured by an "aggressive index;" values greater than 10 indicate nonaggressive or moderately aggressive water while values below 10 indicate highly aggressive water.

If a system is determined to be vulnerable to asbestos contamination in its source water, the proposed rule provides that the system must monitor in accordance with the protocol described above for other source-related inorganics. If the system is vulnerable to asbestos as a corrosion by-product, then the proposed rule requires systems to take a sample at a tap served by asbestos-cement pipe under conditions under which contamination is most likely to occur (i.e., \* \* \* when asbestos cement and corrosive water co-occur). If a system is vulnerable in both respects (in source water and due to corrosion), the proposed rule requires the system to take a sample at a tap served by asbestos-cement pipe under worst-case conditions. EPA believes sampling at the tap is the best approach where both sources of contamination are foreseeable because it will detect asbestos contamination in the source water as well as contamination due to corrosion. If such a sample exceeds the MCL, a system may want to conduct additional monitoring to determine whether the primary cause of

contamination is the source water or due to corrosion of asbestos/cement pipe. EPA solicits comment on whether systems determined by the State to be vulnerable due to contamination of source water as well as corrosion should be required to sample both at the tap and in the distribution system.

EPA also requests comment on the alternative approach of classifying each system as vulnerable unless an assessment by the State determines that the system is not vulnerable. Under this option, all systems would be required to monitor for asbestos unless the State made the affirmative determination that the system was not vulnerable and therefore not required to monitor.

Public comments are requested on all aspects of the proposed monitoring requirements for the inorganic contaminants.

#### D. Volatile Synthetic Organic Chemical Monitoring Requirements

EPA proposes that the compliance monitoring requirements for the ten Group A SOCs (i.e., the volatile organic compounds) be identical to the final monitoring requirements that have already been established for eight volatile organic chemicals (see 52 FR 25690, July 8, 1987) because the factors affecting the potential for contamination of drinking water are the same and the same analytical methods used for the previously regulated VOCs are used to measure the VOCs covered by this proposal. EPA believes this approach is the most effective way to implement this regulation since the addition of these ten compounds to the list of regulated VOCs will only increase monitoring costs slightly. In addition, one round of monitoring for the ten VOCs included in this proposal was required under the Section 1445 monitoring regulations for unregulated VOCs promulgated July 8, 1987 (See 52 FR 25712). Today's proposed regulation would allow the use of previous monitoring data from the Section 1445 monitoring regulation, in lieu of new data, for the initial round of monitoring. EPA's rationale for proposed monitoring requirements for the ten VOCs was previously discussed in the July 8, 1987 notice (52 FR 25712).

EPA is also proposing a modification to the existing monitoring requirements contained in § 141.24(g)(8)(i)(B). The language in that provision has been interpreted to allow vulnerable systems to take only one sample in the initial year of monitoring if no VOCs are detected in the initial sample.

EPA had originally intended, however, for systems that are vulnerable, to conduct quarterly sampling during the first year of monitoring. The Agency

believes that, if a system is determined to be vulnerable, there is the potential that contamination may exist even if none is detected in the first sample and that quarterly monitoring for at least one year is warranted before reducing monitoring to once per year. EPA is therefore proposing to amend § 141.24(g)(8)(i)(B) in order to clarify that vulnerable systems must conduct quarterly monitoring during the first year regardless of whether VOCs are detected in the first sample. The proposed amendment to the existing § 141.24(g)(8)(i)(B) will affect the monitoring for all VOCs, including those regulated by the rule published July 8, 1987. Given the timetable for monitoring for eight VOCs established in that notice, most systems will have already completed the initial year of monitoring by the time this amendment becomes effective. Those systems that have not completed the initial year of monitoring will be required to monitor in accordance with the amended § 141.24(g)(8)(i)(B).

The proposed monitoring requirements for the determination of compliance with MCLs for the Group A SOCs (i.e., VOCs) are as follows:

- All systems must conduct an initial round of quarterly monitoring at least once over the four-year period following promulgation. Monitoring will be phased in based on the system size as follows:

System size	Monitoring completed within
> 10,000 persons served...	18 months of promulgation.
3,300-10,000 persons served.	30 months of promulgation.
< 3,300 persons served....	54 months of promulgation.

- Ground water systems shall sample at points of entry to the distribution system after any treatment. The minimum number of samples for ground water systems is one sample at each entry point to the distribution system, per quarter for one year. However, if a system is determined not to be vulnerable (see 50 FR 46902, November 13, 1985, and 52 FR 25690, July 8, 1987, for a definition of vulnerability) and the first quarterly sample does not detect VOCs, States have the discretion to reduce the initial sampling round from 4 quarterly samples to that one sampling round. The total number of samples which must be analyzed may be reduced, at State discretion, by compositing. Up to 5 samples may be composited. If VOCs are detected in the composite, systems must take a follow-



up sample at each sampling point which was included in the composite. Readers are referred to 52 FR 25713, July 8, 1987, for a more complete discussion about compositing procedures.

- Each laboratory must determine the minimum concentration at which VOCs are detected (i.e., method detection limit (MDL) as defined in Appendix B to Part 136). This concentration must be no greater than 0.0005 mg/l.

- Surface water systems are required to sample at points in the distribution system or at each entry point to the

distribution system which are located after any treatment and which is representative of each source (called a sampling point). Each system must take one sample at each sampling point per quarter for one year. Composite samples from up to five sources are allowed. If VOCs are detected in the composite sample, follow-up monitoring at each sampling point included in the composite sample is required.

- All systems are required to conduct repeat monitoring every 3 or 5 years (depending upon system size) except for

surface water systems that were not vulnerable and did not detect any VOCs in the first round of sampling. (EPA defines the detection level as 0.0005 mg/l.) Systems which detect VOCs in the initial round of sampling or any subsequent round are required to monitor quarterly. The repeat monitoring frequency is based on prior monitoring results, system vulnerability, and system size.

#### SCHEDULE OF REPEAT MONITORING REQUIREMENTS

Status	Ground water	Surface water <sup>1</sup>
VOCs not detected <sup>2</sup> and not vulnerable.....	Repeat every 5 years.	State discretion.
VOCs not detected and vulnerable: Systems > 500 connections .....	Repeat every 3 years.	Repeat every 3 years.
Systems < 500 connections.....	Repeat every 5 years.	Repeat every 5 years.
VOCs detected.....	Quarterly.....	Quarterly.

<sup>1</sup> Surface water systems sample during four consecutive quarters.

<sup>2</sup> Detected = 0.0005 mg/l.

- States have discretion to:
  - Require confirmation samples for positive results.
  - Reduce the repeat monitoring requirements for systems detecting VOCs but at levels consistently less than the MCL. The reduction can be from quarterly sampling to no less than annually after a three-year data baseline is developed.
  - allow the use of previous monitoring data of acceptable quality in lieu of new data to satisfy the initial monitoring requirement if the system is not vulnerable.

- MCL compliance is based upon a running annual average of quarterly samples at each sampling point (i.e., the previous four quarterly samples). If the annual average at any sampling point is above the MCL, the entire system is out of compliance and public notification of the system's customers is required.

- If monitoring is conducted annually or less frequently and if the State reduces the initial quarterly monitoring requirement to one sample, then the compliance determination is based upon that one sample.

#### E. Pesticide and PCB Monitoring Requirements

In order to propose monitoring requirements for the pesticides and PCBs, EPA evaluated which sampling frequencies and locations provide the best information on whether water delivered to the consumer complies with

the MCL at reasonable sampling and analytical costs.

When developing the July, 1987 VOC monitoring requirements, EPA used occurrence data gathered primarily from EPA and State sponsored surveys. Due to the occurrence of VOCs, the incidence of contamination was correlated with size of the population served by the system (i.e., the likelihood of contamination increases for large systems). However, the occurrence data also supported the decision that all systems should monitor for VOCs since both small and large systems have detected VOCs at relatively high concentrations. That decision was supported by the fact that a single analytical method measures all the VOCs included in the July, 1987 notice at about \$200 per sample. Consequently, EPA promulgated VOC monitoring requirements that would first require larger systems to monitor and subsequently phase in the smaller systems over a period of several years. EPA reasoned that larger systems could best afford the sampling and analytical costs associated with the monitoring and should be required to monitor first.

Determining which systems should monitor for pesticides and PCBs is a more complex problem than for the VOCs because national survey data does not clearly define the extent of the contamination problem. In addition, EPA believes the occurrence potential for most contaminants is limited based on previous survey data. For example,

manufacture of PCBs was discontinued in the U.S. in 1976. However, contamination potential still exists, primarily from capacitors and transformers.

There are many point and non-point sources of pesticide contamination. Point sources may include spills and leaks of pesticides at manufacturing, distribution, or storage facilities, or from hazardous and municipal waste landfills and other waste handling of treatment facilities. The use of pesticides to control insect and weed pests on agricultural areas, forest lands, home and gardens, and other land applications contribute to non-point sources pollution of drinking water sources. Pesticide contamination, largely due to sanctioned pesticide use in agricultural areas, most likely affects small systems. In addition, a single analytical method does not exist to analyze all the pesticides. Rather, a minimum of four separate analytical methods must be used to analyze all the pesticides/PCBs included in today's notice. EPA estimates each analytical method costs \$200 per sample analyzed.

In order to ensure that monitoring costs are reasonable, the proposed requirements target compliance monitoring to community and non-transient, non-community water systems which are vulnerable to contamination. Because local pesticide use and the existence of capacitors and transformers are the primary factors in determining



vulnerability, EPA believes that the States are in the best position to assess a system's vulnerability. Appendix B of this notice provides guidance on the factors which may influence the vulnerability of systems to contamination by pesticides/PCBs.

EPA considered three options related to the specific monitoring requirements for pesticides and PCBs. The options were: Option #1: Monitoring requirements should only apply to vulnerable systems; Option #2: EPA would require all systems to conduct one round of monitoring unless the State waives the requirement on a case-by-case basis; and Option #3: Vulnerable ground water systems would take a minimum of a single quarterly sample during the period of highest vulnerability; surface water systems would take four quarterly samples. Under Option 3, if ground water systems detected no contaminants in the initial sample, additional monitoring would not be required. If systems do not detect contamination at the period of highest vulnerability, it may be unlikely that future contamination would be detected. However, EPA asks for comment on the ability of the State to reliably estimate the period of highest vulnerability.

Today's proposal proposes Option #1 (only vulnerable systems are required to monitor for pesticides and PCBs for four quarters). EPA believes this option provides the greatest opportunity for States to target monitoring to those areas where problems are likely to occur. Public comment is requested on the chosen option and the other two options presented above.

The proposed monitoring requirements described below for the pesticides and PCBs are similar to those for VOCs, with a few exceptions as follows: (1) Systems must monitor only for those contaminants to which they are vulnerable; (2) sampling must occur during periods when contamination is most likely to occur (e.g., after first rainfall during application season for pesticides for surface water sources); and (3) the repeat monitoring requirements are not as stringent for small systems (i.e., <500 connections) because the pesticide/PCB monitoring costs are higher. These costs would impose a significant economic burden on small systems.

The proposed monitoring requirements to determine compliance with the MCLs for the Group B organics (i.e., pesticides and PCBs) are:

- Monitoring will be phased in over four years. Vulnerable systems (as determined by the State) must monitor at least quarterly for one year during the initial four years.

- Each State will determine which systems are vulnerable within 18 months after promulgation of the final rule after considering factors that influence vulnerability described in Appendix B. EPA will provide general procedures that the States may use to conduct vulnerability assessments of systems to contamination in a guidance document.

- Systems which detect pesticides/PCBs remain vulnerable to the contaminants detected for a minimum of three years. After three years the State can reclassify the system based upon a new assessment.

- Vulnerable ground water systems must take a minimum of one sample at every entry point to the distribution system which is representative of each well after treatment. For the initial round of monitoring, each system must sample quarterly for one year. Repeat sampling frequencies are based on system size and whether pesticides/PCBs are detected (see Table 31).

- The State may reduce the total number of samples by allowing use of composite samples from up to five entry points if the composite reflects the system's normal operating characteristics (i.e., if the composite is representative of each well that is operating). If contamination is detected in a composite sample follow-up sampling is required at each entry point included in the composite.

- Surface water systems must sample at points in the distribution system that are representative of each source or at each entry point to the distribution system which is located after any treatment. For the initial round, each system must monitor quarterly for one year. EPA is proposing that a surface water system may sample more frequently than quarterly. The rationale for allowing more frequent sampling for surface systems is that monitoring results are more variable than for ground water systems. Because monitoring is required at periods of highest vulnerability, the four quarterly samples may not reflect actual exposure. Surface water systems may at their option monitor more frequently as long as all samples taken are used to determine compliance and the sampling design chosen is representative. For example, a representative design is sampling on the same day of the month or at consistent intervals between samples. EPA believes that additional sampling will result in better estimates of the likelihood that the annual average exposure exceeds the MCL, especially when contamination levels vary significantly. Repeat sampling frequencies are based on system size

and whether pesticides/PCBs are detected (see Table 31).

TABLE 31.—FREQUENCY OF REPEAT MONITORING REQUIREMENTS FOR PESTICIDES/PCBs (VULNERABLE SYSTEMS ONLY)

Status	Ground water	Surface water
SOCs are not detected <sup>1</sup>		
Systems > 500 connections.	Repeat every 3 years.	Repeat quarterly every 3 years <sup>1</sup> .
Systems < 500 connections.	Repeat every 5 years.	Repeat quarterly every 5 years <sup>1</sup> .
SOCs detected <sup>2</sup>		
Systems > 500 connections.	Quarterly.....	Quarterly <sup>3</sup> .
Systems < 500 connections.	Annually.....	Annually <sup>3</sup> .

<sup>1</sup> Must sample for four consecutive quarters.

<sup>2</sup> Detection—the MDL as defined in Table 14.

<sup>3</sup> The number of samples required varies for ground and surface water systems because of the likelihood of short term variability of contaminant concentration in surface water sources. Since greater fluctuations in concentration are more likely to occur in surface water systems (and ground water systems directly influenced by surface water) such systems must monitor more frequently (i.e., quarterly) during the monitoring period.

- Systems must monitor during periods of highest vulnerability (i.e., after rain and application of pesticides, fertilizer).

- States have the discretion to:

- Require confirmation samples for positive results.
- Reduce the repeat monitoring requirements for systems >500 service connections which detect contamination, but at levels <50 percent of the MCL. The reduction from quarterly to annually is allowed after 3 years of quarterly monitoring is completed.
- Reduce the monitoring frequency for vulnerable ground water systems which do not detect pesticides/PCBs from annually to every 3 years after 3 years of annual sampling is completed.
- Allow the use of monitoring data collected after January 1, 1986, in lieu of new data for the initial sample provided the data are of acceptable quality and provide information equivalent to that required in the proposed rule. EPA requests comments on whether it is reasonable to allow systems to use data collected after January 1, 1986 to satisfy the compliance monitoring requirement or whether more recent data should be specified.



• Compliance determination with the MCLs for pesticides and PCBs is as follows:

—For ground water systems which monitor quarterly, compliance is based upon a running annual average of quarterly samples at each sampling location (i.e., the previous four quarterly samples). If the annual average at any sampling location is above the MCL, the system is out of compliance and public notification is required. For surface water systems, which monitor quarterly or more frequently, compliance is based upon a running annual average of all samples taken at each sampling point. If the annual average at any sampling location is above the MCL, the system is out of compliance and public notification is required.

—For systems which monitor annually or less frequently, compliance is based upon one sample. If a confirmation sample is required, the determination of compliance will be based on the average of the two samples.

—If any one quarterly sample causes the annual average to be exceeded, the system is out of compliance immediately. For example, if the sample exceeded the MCL by as many times as there would be samples in that year (i.e., 4 times if quarterly, 12 times if monthly), the system would be out of compliance immediately. This results in early notification of potential health risks to consumers. In addition, if at any point during the sampling year, it is clear the MCL would be exceeded, the system is out of compliance immediately.

Public comments are requested on all aspects of the proposed monitoring requirements for inorganic, VOC, pesticide, and PCB contaminants. EPA specifically requests comments on the following issues:

• Should the monitoring requirements apply only to vulnerable systems or should all systems conduct at least one initial round of monitoring?

• Are the sampling locations, number of samples per system and sampling frequency adequate to measure drinking water quality?

• Are the proposed requirements affordable by public water systems, especially small systems?

• Is the active role of the States to determine each system's vulnerability and the repeat monitoring frequencies a reasonable expectation?

• Should EPA require States to conduct periodic vulnerability assessments (i.e., every 3 or 5 years).

• Whether systems which did not detect pesticides which were cancelled (Chlordane, PCBs, Silvex, Hepachlor, Toxaphene, EDB, DBCP) in the initial monitoring round should be presumed to be reclassified as not vulnerable. Future monitoring would not be required unless the State reclassifies the system as vulnerable to the cancelled pesticides.

• Whether systems are allowed to composite samples without State approval. Under this scenario, systems or laboratories would decide whether to composite rather than the State. However, because States may adopt regulations limiting compositing which are more stringent than Federal requirements, States may limit compositing requirements as part of State regulations. EPA solicits comments on the problems and benefits compositing may provide. For example, certain contaminants such as PCBs and chlordane may adhere to sample bottles and could be missed if sampling techniques fail to obtain a representative sample. Is this a problem and are there techniques to overcome this limitation. Where technically feasible, compositing should reduce monitoring costs and will reduce demand on limited laboratory capacity.

In addition to the proposed monitoring requirements, EPA is considering an alternative monitoring scheme and may adopt it in the final rule. Under this alternative, all community and non-transient, non-community public water systems would be required to monitor for asbestos and the pesticides/PCBs at the locations and the frequencies specified in § 141.23 and § 141.24, as appropriate. The States would not be required to conduct vulnerability assessments to determine which systems would be required to monitor and at what intervals. Vulnerability assessments would be required only when a system wished to decrease the monitoring required by § 141.23 and § 141.24. If a system wished to decrease the monitoring requirements, it would have to submit documentation to the State demonstrating that the reduced monitoring frequencies were appropriate. The State would then make a decision on the system's request based on the data the system submitted and its own vulnerability assessment.

The major difference between this alternative and EPA's proposal is that the alternative shifts the workload burden from the States to the public water systems; that is, the burden is on the system to monitor or to demonstrate to the State that its unique circumstances justify a change in the monitoring requirements. (Under the current proposal, the burden is on the

State to notify the system that it is vulnerable and that it must monitor.)

EPA solicits comments from all parties on this alternative approach. EPA is especially interested on the impact of this alternative on both the public water systems and on State programs.

## VII. Laboratory Approval

EPA recognizes that the effectiveness of the proposed regulations is dependent upon the ability of laboratories to reliably analyze contaminants at relatively low levels. The existing drinking water laboratory certification program (LCP) established by EPA requires that only approved laboratories may analyze compliance samples.

The LCP uses external checks of performance to evaluate a laboratory's ability to analyze samples for specific contaminants within specific limits. For this purpose, EPA provides performance evaluation (PE) samples to laboratories on a regular basis; participation in this program is a prerequisite for a laboratory to achieve certification and to remain certified for analyzing compliance samples. Achieving acceptable performance in these studies of known test samples provides some indication that the laboratory is following proper practices.

Unacceptable performance may be indicative of problems that could impact on the reliability of the compliance data.

Unacceptable performance should trigger an investigation to establish the possible cause(s) and to take corrective action. EPA recognizes that even a superior analytical laboratory occasionally produce data which is outside the acceptable limits due to statistical reasons rather than from any actual analytical problems. A provision for rapid follow-up analysis is necessary if a laboratory fails the initial determination to decrease the likelihood of statistical error and to determine if a real problem exists.

EPA's present PE sample program and the approaches used to determine laboratory performance requirements were discussed at 50 FR 46907 (November 13, 1985). Acceptable performance has historically been set by EPA using two different approaches: (1) regressions from performance of pre-selected laboratories, or (2) specified accuracy requirements. EPA requested public comment on these approaches in the November 13, 1985 notice. Most commenters supported the use of a "plus or minus percent of the true value" approach to derive acceptance limits instead of generating performance requirements from study statistics. EPA



agrees with these commenters and will specify accuracy requirements in the revised regulations, whenever possible. This approach involves the specification of a "plus or minus percent of the true value" for setting acceptance limits.

The acceptance limits are derived from an evaluation of existing PE study data. Under some circumstances, when there is insufficient information to determine the expected performance for analytical laboratories because the analytical methods are new and the contaminants have not been included in PE studies, EPA will determine the acceptance limits from individual study statistics based upon 95 percent confidence limits (refer to Section IV for additional information). After sufficient performance data are generated from PE studies, EPA will develop acceptance limits using a "plus or minus percent of the true value approach."

#### A. Inorganic Chemicals

EPA evaluated performance data gathered from past PE studies to set performance requirements for the inorganics. Performance data are available for all the inorganics with the exception of nitrite and asbestos. The available PE data indicate that both the precision and the accuracy attained for specific inorganic contaminants are contaminant-specific. For example, the percent recoveries are between 93 and 100 percent, while the relative standard deviations are between 4 and 14 percent for the inorganics in this proposal. The "plus or minus percent of the true value" acceptance limits have been derived for each contaminant taking into consideration the expected precision and accuracy and using 95 percent confidence limits to estimate the acceptance limits. For example, the percent recovery for chromium is 100 percent and the relative standard deviation is 7 percent. The acceptance limits using 95 percent confidence limits would be  $100\% \pm 2(7\%)$  or 86 to 114% of the "true value." Thus, a  $\pm 15\%$  of the "true value" acceptance limit is approximately equal to the 95% confidence limits. The acceptance limits for the other inorganics were estimated using a similar approach. The acceptance limits for nitrite will be the same as for nitrate for the reasons discussed earlier (i.e., the analytical procedures used for nitrite determination and the MDLs are similar to nitrate). The acceptance limits only apply to concentrations  $\geq$  PQL. The reader should note that fluoride acceptance limits are also proposed in this proposal since they were not previously established.

The acceptance limits are summarized below:

Contaminant	Acceptance limits
Asbestos.....	Two standard deviations based on study statistics.
Barium.....	$\pm 15$ percent at $> .15$ mg/l.
Cadmium.....	$\pm 20$ percent at $> .002$ mg/l.
Chromium.....	$\pm 15$ percent at $> .01$ mg/l.
Fluoride.....	$\pm 10$ percent at 1 to 10 mg/l.
Mercury.....	$\pm 30$ percent at $> .0005$ mg/l.
Nitrate.....	$\pm 10$ percent at $> .4$ mg/l.
Nitrite.....	$\pm 10$ percent at $> .4$ mg/l.
Selenium.....	$\pm 20$ percent at $> .01$ mg/l.

Public comments are requested on the acceptance limits for the inorganics.

#### B. Synthetic Organic Chemicals

##### 1. Volatile Synthetic Organic Chemicals

The proposed performance requirements are the same as the performance requirements established for the 8 VOCs promulgated July 8, 1987 since laboratory performance for the VOCs was similar. Laboratory studies show that approximately 85-90% of the EPA and State laboratories will be within  $\pm 40\%$  of the true value for concentrations less than 10  $\mu\text{g/l}$  and within  $\pm 20\%$  of the true value for levels above 10  $\mu\text{g/l}$ . Therefore, the acceptance limits for the VOCs are  $\pm 20\%$  of the true value for concentrations of 10  $\mu\text{g/l}$  or above and  $\pm 40\%$  of the true value for concentrations below 10  $\mu\text{g/l}$ .

Public comments are requested on the proposed acceptance limits for the VOCs.

##### 2. Pesticides and PCBs

There are no performance evaluation study data for these contaminants at the present time because the analytical methods were only recently developed. Therefore, specified accuracy requirements for laboratory performance cannot be established until more information is available on the actual performance of these methods at different analytical laboratories. In the interim, acceptable performance for laboratory certification for these contaminants will be based on acceptance limits generated from individual study statistics using two standard deviations (i.e., 95 percent confidence limits using study statistics). EPA will collect performance data from future PE studies and then develop accuracy requirements of laboratory performance based on a plus or minus percent of the true value.

Public comments are requested on the use of two standard deviations (i.e., confidence intervals generated from individual study statistics) to determine

acceptance limits for the pesticides and PCBs in this proposed rule.

#### VIII. Monitoring for Unregulated Contaminants

Requirements are proposed in this notice to monitor for other "unregulated" contaminants. "Unregulated contaminants" are those contaminants for which EPA establishes a monitoring requirement but the contaminant does not have an associated MCLG and MCL or treatment technique. The discussion below describes the statutory authority, provides background information, and describes the proposed requirements.

##### A. Statutory Authority

The establishment of monitoring regulations is authorized by section 1445(a)(1) of the SDWA which states:

Every person who is a supplier of water, \* \* \* shall establish and maintain such records, make such reports, conduct such monitoring, and provide such information as the Administrator may reasonably require by regulation to assist him in establishing regulations, \* \* \* in evaluating the health risks of unregulated contaminants or in advising the public of such risks.

Further, section 1445(a)(2) of the SDWA require the EPA to promulgate monitoring requirements for unregulated contaminants:

\* \* \* The Administrator shall promulgate regulations requiring every public water system to conduct a monitoring program for unregulated contaminants. The regulations shall require monitoring of drinking water supplied by the system and shall vary the frequency and schedule of monitoring requirements for systems based on the number of persons served by the system, the source of supply, and the contaminants likely to be found. Each system shall be required to monitor at least once every 5 years after the effective date of the Administrator's regulations unless the Administrator requires more frequent monitoring.

EPA fulfilled the statutory mandate contained in section 1445 (c)(2) of the Act by promulgating regulations establishing monitoring requirements for unregulated contaminants on July 8, 1987 (52 FR 2590). EPA is proposing additional monitoring requirements pursuant to section 1445 (a)(1) to assist the Agency in establishing future NPDWRS.

##### B. Background

In recent years, numerous chemical contaminants have been found in drinking water. Assessment of the quality of drinking water in the U.S. has been accomplished through various monitoring activities including: (1) Compliance monitoring for the primary



and secondary Federal drinking water standards, (2) compliance monitoring for certain State developed drinking water standards, (3) EPA conducted national statistically designed surveys of selected drinking water supplies, (4) State surveys, (5) responses to contamination incidents, and (6) research studies.

These monitoring activities can determine in part the quality of the nation's drinking water. However, most small (and many large) public water systems are unaware of possible contamination of their supplies. Except for certain large systems and those systems in a few States with aggressive monitoring programs, very little ongoing monitoring occurs of potential contaminants not yet regulated in drinking water. Consequently, EPA believes that a systematic and comprehensive monitoring program is needed to determine the quality of water delivered by public water systems. This program would enhance public awareness of drinking water, quality encourage control actions, when appropriate, before standards are implemented, and provide data useful in developing regulations in the future.

EPA recognized the need for a national monitoring program several years ago. In 1984, EPA sponsored a public workshop to discuss the need to monitor unregulated drinking water contaminants. State, utility, public interest group, analytical laboratory, and individual consultant representatives attended the workshop. The workshop split all organic chemicals that were considered to be potential drinking water contaminants into two groups: VOCs and pesticides and other higher molecular weight synthetic organic chemicals. The workshop participants recommended that:

- EPA should initially develop monitoring regulations for unregulated VOCs for all community water systems.
- EPA should next develop monitoring regulations for a limited number of pesticides/SOCs which have sufficient information on occurrence and system vulnerability and for which analytical methods are available. Pesticide/ SOC monitoring should be directed at those Contaminants most likely to occur.
- Before additional pesticide monitoring requirements are

established, EPA should develop additional analytical methods and derive information on system vulnerability.

- States should have flexibility to design monitoring programs which reflect regional priorities and concerns.

The National Drinking Water Advisory Council (NDWAC) also considered this issue in 1984 and recommended that EPA develop monitoring regulations for a limited number of pesticides for which analytical capabilities exist.

Since the 1984 Workshop, EPA promulgated monitoring regulations for 50 unregulated VOCs on July 8, 1987 (52 FR 25709). In order to establish MCLs for pesticides and PCBs, EPA recently developed analytical methods to analyze these contaminants. A residual benefit of the new methods is that they will also detect other chemicals which occur in drinking water.

#### *C. Summary of Unregulated Contaminant Monitoring Requirements*

EPA proposes monitoring requirements for approximately 110 "unregulated" organic chemical and 6 inorganic contaminants. These "unregulated" contaminants are divided into two groups. The monitoring requirements for contaminants in the first group only apply to those systems vulnerable to contamination to the listed chemicals. States may require monitoring contaminants in the second group based on local concerns and priorities.

For the first list of 29 organic and inorganic contaminants, the State must conduct a vulnerability assessment for each contaminant. The vulnerability assessment will determine the specific contaminants which community and non-transient, non-community systems must monitor based on factors such as chemical use, hydrogeology, or other factors.

#### *1. Selection of Chemicals*

Two factors were considered to select the specific contaminants for "unregulated contaminant" monitoring. First, EPA included those contaminants which section 1412 of the SDWA directs EPA to regulate and which are not covered by this notice (the list of 83 contaminants). Since those contaminants will be regulated by EPA in future rulemaking it is reasonable to

have systems begin monitoring for the contaminants. Analytical methods 505, 507, 508, 515.1, and 531.1 can analyze over one hundred pesticides, including all the organic contaminants included in this proposal. The second factor was used to discriminate those pesticides of higher priority and certain inorganic chemicals, based on previous detection in drinking water.

EPA believes that the monitoring requirements should focus on those chemicals of greatest concern in drinking water. However, the Agency does not want to rule out other chemicals that may pose an adverse health risk and that can be measured with little additional analytical effort. Therefore, the Agency proposes that the State conduct system specific vulnerability assessments for 23 pesticides/SOCs and six inorganic contaminants. Systems must complete monitoring for these priority #1 contaminants within four years of promulgation of the final rule. States may require systems to monitor for the remaining 84 contaminants (priority #2) at its discretion. All pesticides (except two) in the second priority list can be analyzed using EPA Methods 507 and 508.

The two priority groups of contaminants are listed in Tables 32 and 33. EPA requests comments on the specific contaminants and their priority listed in these tables. Readers should note that only vulnerable systems, as determined by the State, need to monitor for priority contaminants listed in Table 32. Monitoring for priority 2 contaminants is at State discretion. These contaminants are listed in Table 33.

Analysis for unregulated contaminants must be conducted in laboratories certified by the State or EPA. EPA will provide interim certification to those laboratories that analyze performance evaluation samples within the acceptance limits established by the EPA using approved analytical methodology. The laboratory can use this interim certification until a full certification program is completed. The acceptance limits for unregulated contaminants in this proposal are based on two standard deviations (i.e., 95 percent confidence limits based on study statistics).



TABLE 32.—UNREGULATED CONTAMINANTS MONITORING FOR PRIORITY #1 CONTAMINANTS—VULNERABLE SYSTEMS<sup>1</sup>

Contaminant	Method
<b>SOCs:</b>	
Hexachlorobenzene .....	505, 508
Dalapon .....	515.1
Dinoseb .....	515.1
Picloram .....	515.1
Oxamyl (vydate) .....	531.1
Simazine .....	505, 507
Glyphosate .....	547
Hexachlorocyclopentadiene .....	505, 525
PAHs .....	550, 550.1, 525
Phthalates .....	506, 525
2,3,7,8-TCDD (Dioxin) ....	513
Aldrin .....	505, 508
Dieldrin .....	505, 508
2,4-DB .....	515.1
Dicamba .....	515.1
2,4,5-T .....	515.1
Carbaryl .....	531.1
3-Hydroxycarbofuran .....	531.1
Methomyl .....	531.1
Butachlor .....	505, 507
Metolachlor .....	505, 507
Propachlor .....	505, 507
Metribuzin .....	507
<b>IOCs:</b>	
Antimony .....	Graphite Furnace Atomic Absorption; Inductively Coupled Plasma.
Beryllium .....	Atomic Absorption; Inductively Coupled Mass Spectrometry Plasma; Spectrophotometric.
Nickel .....	Atomic Absorption; Inductively Coupled Mass Spectrometry Plasma; Graphite Furnace Atomic Absorption.
Sulfate .....	Colorimetric.
Thallium .....	Graphite Furnace Atomic Absorption; Inductively Coupled Mass Spectrometry Plasma.
Cyanide .....	Spectrophotometric.

<sup>1</sup> Monitoring required for all contaminants for which systems are determined by the State to be vulnerable.

TABLE 33.—UNREGULATED CONTAMINANTS MONITORING FOR PRIORITY #2 CONTAMINANTS—STATE DISCRETION<sup>1</sup>

## Contaminants Analyzed Using Method 507:

Ametryn  
Aspon  
Atraton  
Azinphos methyl  
Bolstar  
Bromacil  
Butylate  
Carboxin  
Chlorpropham  
Coumophos  
Cycloate  
Demeton-O  
Demeton-S  
Diazinon  
Dichlofenthion

TABLE 33.—UNREGULATED CONTAMINANTS MONITORING FOR PRIORITY #2 CONTAMINANTS—STATE DISCRETION<sup>1</sup>—Continued

Dichlorvos  
Diphenamid  
Disulfoton  
Disulfoton sulfone  
Disulfoton sulfoxide  
EPN  
EPTC  
Ethion  
Ethoprop  
Ethyl parathion  
Famphur  
Fenamiphos  
Fenarimol  
Fenitrothion  
Fensulfothion  
Fenthion  
Fluridone  
Fonofos  
Hexazinone  
Malathion  
Merphos  
Methyl paraoxon  
Methyl parathion  
Mevinphos  
MGK 264  
MGK 326  
Molinate  
Napropamide  
Norflurazon  
Pebulate  
Phorate  
Phosmet  
Prometon  
Prometryn  
Pronamide  
Propazine  
Simetryn  
Sirofos  
Tebuthiuron  
Terbacil  
Terbufos  
Terbutryn  
Triademeton  
Tricyclazole  
Vernolate

## Contaminants Analyzed Using Method 508:

Chlorneb  
Chlorobenzilate  
Chloropropylate  
Chlorothalonil  
Chlorpyrifos  
DCPA  
4,4'-DDD  
4,4'-DDE  
4,4'-DDT  
Dichloran  
Endosulfan I  
Endosulfan II  
Endosulfan sulfate  
Endrin aldehyde  
Etridiazole  
HCH-alpha  
HCH-beta  
HCH-delta  
HCH-gamma  
cis-Permethrin  
trans-Permethrin  
Trifluralin

## Contaminants Analyzed Using Other Methods:

Diquat—Method 549  
Endothall—Method 548.

<sup>1</sup> Monitoring for these contaminants is at the discretion of the State.

## 2. Proposed Monitoring Requirements for Unregulated Contaminants

The monitoring requirements for the unregulated SOCs and inorganics are similar to the monitoring requirements previously described for inorganics and pesticides/PCBs compliance monitoring (See section VI of this proposal). The unregulated contaminant monitoring specifies the same sampling locations and the same minimum number of samples which must be collected and analyzed. Monitoring for the 29 priority #1 contaminants must be completed within four years of promulgation.

EPA believes the proposed monitoring requirement for unregulated contaminants gives the States flexibility to design a program that targets monitoring to those systems which are potentially vulnerable to contamination. Unlike the monitoring requirements for the regulated pesticides/PCBs which specify repeat frequencies, monitoring for unregulated contaminants involves only one round of monitoring. For the unregulated contaminants, though not required, EPA recommends that systems perform confirmatory analyses and that States follow up any detected contamination to determine the precise nature of the problem.

The proposed community and non-transient, non-community monitoring requirements for the unregulated SOCs are as follows:

- For the priority #1 contaminants, states must determine which systems are vulnerable to the contaminants list in Table 32. Monitoring for the contaminants listed in Table 33 is at State discretion.
- For the inorganics, the vulnerability assessment considers potential contamination of the water source. For the SOCs, the assessment considers previous results, the proximity to potential point and non-point sources of contamination, environmental persistence, how well the source is protected, and nitrate levels. EPA notes that systems are only required to monitor for the specific contaminants to which the State determines they are vulnerable to.
- For the priority #1 contaminants, all vulnerable systems must monitor quarterly at each sampling point for one year over the four-year monitoring period.
- Ground water systems must sample at each entry point to the distribution system which is located after treatment. Surface water systems must take a minimum of one sample at points in the



distribution system that are representative of each source or at each entry point to the distribution system and which is representative of each source.

- The State may reduce the total number of samples by the use of composite samples of multiple entry points (up to five entry points per sample) if the composite reflects operating characteristics. If contamination is detected in a composite, follow-up sampling is required from each sample included in the composite.

- The State may require systems to take a confirmation sample.

The proposed monitoring requirements for the IOCs are similar to the monitoring requirements previously described for barium, cadmium, chromium, mercury and selenium. Only one round (one sample) of monitoring is required for the unregulated inorganics. The proposed monitoring requirements are as follows:

- The State shall determine which systems are vulnerable. All vulnerable systems shall monitor once within the four-year monitoring period.

- Systems must sample at entry points to the distribution system for groundwater systems. Surface water systems must sample at entry points to the distribution system or in the distribution system, at points representative of each source or treatment plant. One sample at each sampling point is required.

- The total number of samples may be reduced at the discretion of the State by the use of composite samples. Composite samples from five sources are allowed. If contamination by one or more IOCs is detected, follow-up sampling at each sampling point included in the composite sample is required.

As with the proposed monitoring requirements for the regulated contaminants, EPA is considering an alternative monitoring scheme for the unregulated contaminants. EPA may adopt this alternative in the final rule. Under this alternative, EPA would require all community and non-transient, non-community water systems to conduct one round of monitoring for the unregulated contaminants as specified in § 141.40(m) (organics) and § 141.40(n) (inorganics). No vulnerability assessments would be required. The major difference between the proposal and the alternative is that the alternative monitoring scheme places the burden on the system to perform the monitoring as opposed to placing it on the State to perform an assessment to determine which systems must monitor.

The State would have the discretion to exempt systems from monitoring for one, several, or all of the unregulated contaminants if system submitted documentation to the State showing that it was not vulnerable to contamination by the contaminant(s) for which it did not wish to monitor. The State would then make a determination based on the system's submission and its own assessment of the circumstances.

EPA solicits comments from all parties on the alternative monitoring scheme. EPA is especially interested in the effects of the alternative on both the water systems and on the State programs.

Public comments are requested on the need for monitoring for unregulated contaminants specified in this notice and on specific aspects of the proposed requirements.

#### IX. State Implementation

The Safe Drinking Water Act provides that States may assume primary implementation and enforcement responsibilities. Fifty-four out of 57 jurisdictions have applied for and received primary enforcement responsibility (primacy) under the Act. To implement the Federal regulations for drinking water contaminants, States must adopt their own regulations which are at least as stringent as the Federal regulations. This section of today's proposal describes the regulations and other procedures/policies the States must adopt to implement today's proposed rule. EPA has previously proposed to revise existing program implementation requirements of 40 CFR Part 142, August 2, 1988 (53 FR 29194).

To implement today's proposed rule, States will be required to adopt the following regulatory requirements: when they are promulgated: § 141.23, Inorganic Chemical Sampling and Analytical Requirements; § 141.24, Organic Chemical Other than Total Trihalomethanes Sampling and Analytical Requirements; § 141.32, General Public Notice Requirements (i.e., mandatory health effects language to be included in public notification of violations); § 141.40, Special Monitoring for Inorganic and Organic Chemicals; § 141.61 (a) and (c), Maximum Contaminant Levels for Organic Contaminants; § 141.62, Maximum Contaminant Levels for Inorganic Chemicals; and § 141.111, Treatment Techniques for Acrylamide and Epichlorohydrin.

In addition to adopting drinking water regulations no less stringent than the federal regulations listed above, EPA is proposing that States adopt certain requirements related to this regulation in

order to have their program revision application approved by EPA. In various respects the proposed NPDWRs provide flexibility to the State with regard to implementation of the monitoring requirements by this rule. Because State determinations regarding vulnerability and monitoring frequency will have a substantial impact with implementation of this regulation, the proposed rule requires States to submit as part of their State program submissions their policies and procedures in these areas. This will serve to inform the regulated community of State requirements and also help EPA in its oversight of State programs. These proposed requirements are discussed below under the section Special Primacy Requirements.

Today, EPA is also proposing changes to State recordkeeping and reporting requirements. EPA's proposed changes are discussed below. EPA requests comments on these proposed requirements.

#### A. Special State Primacy Requirements

To ensure that the State program includes all the elements necessary for an effective and enforceable program, EPA proposes that, to obtain EPA approval of program revisions, the State's request for approval must contain the following:

(1) The procedures and/or policies the State will use to conduct vulnerability assessments. These procedures/policies must include the factors the State will use in conducting vulnerability assessments and the methods the State will use to inform each system of its vulnerability classification. The procedures must also include procedures and factors to be followed for reclassifying systems with regard to their vulnerability.

(2) The procedures/policies the State will use to allow a system to decrease its monitoring frequency. The policies/procedures must include the factors a State will use in making this determination as well as the method the State will use to inform the system of its new required monitoring frequency.

#### B. State Recordkeeping Requirements

The current regulations in § 142.14 require States with primary enforcement responsibility to keep records of analytical results to determine compliance, system inventories, sanitary surveys, State approvals, enforcement actions, and the issuance of variances and exemptions. States must keep records for forty years. In this proposal EPA would require that States keep additional records of:



(1) System vulnerability determinations and the basis for the determination.

(2) Any determinations that a system may decrease the repeat monitoring frequency for the inorganic chemicals and pesticides/PCBs. The records must include the basis for the decision and the new monitoring frequency.

(3) Any determinations that a system is required to conduct repeat monitoring for asbestos when the initial analytical result is <50% of the MCL, the basis for the decision, and the repeat monitoring frequency.

(4) Decisions that systems must monitor for the unregulated contaminants.

(5) Letters received from systems serving less than 150 service connections stating that the system is available for sampling for the "unregulated contaminants."

(6) Annual certifications received from systems that when acrylamide and epichlorohydrin are used in drinking water systems that the combination of dose and monomer levels do not exceed the specified levels.

Since the above determination and information will determine the monitoring requirements applicable to a system and will indicate whether a system is complying with the treatment technique requirement in the proposed rule.

EPA believes that the additional State recordkeeping requirements are necessary for effective EPA oversight of State primacy programs. EPA request public comments on these proposed requirements. EPA is also soliciting comments on the existing 40 year State recordkeeping requirement. EPA desires comment on whether this requirement should be modified.

### C. State Reporting Requirements

EPA currently requires in § 141.15 that States report to EPA information such as violations, variances and exemption status, enforcement actions, etc. EPA proposes in this notice that in addition to the current reporting requirements, States report to EPA:

(1) A list of all systems on which the State conducted a vulnerability assessment, the results of that assessment, and the basis for the determination.

(2) A list of all systems for which the State reduced the monitoring frequency, the new required monitoring frequency, and the basis for the State's decision.

(3) A list of all systems which the State determines must conduct repeat monitoring for asbestos.

(4) The results of any monitoring for the "unregulated contaminants" listed in § 141.40 (m), (n), and (o).

(5) A list of all systems serving less than 150 service connections which during the previous quarter sent a letter to the State stating its availability for sampling for the "unregulated contaminants."

(6) A list of those systems which certified compliance with the treatment technique requirements for epichlorohydrin and acrylamide.

EPA believes that the State reporting requirements contained in this proposal are necessary to ensure effective oversight of State programs. Public comments on these proposed State reporting requirements are requested. EPA particularly requests comments from States on whether the proposed reporting requirements are reasonable.

### X. System Reporting Requirements

The current regulations, 40 CFR 141.31, require public water systems to report monitoring data to States within ten days after the end of the compliance period. No changes are proposed to those requirements.

### XI. State Wellhead Protection Programs

Section 1428 of the SDWA contains requirements for the development and implementation of State WHP Programs and authority for Federal grants. Specifically, subsections 1428 (a) and (b) provides that each State, including the District of Columbia and the eligible territories, shall adopt and submit to the Environmental Protection Agency (EPA) a WHP Program that, at a minimum:

1. Specifies the duties of State agencies, local governmental entities and public water supply systems with respect to the development and implementation of Programs.

2. For each wellhead, determines the wellhead protection area (WHPA) as defined in subsection 1428(e) based on all reasonably available hydrogeologic information on ground water flow, recharge and discharge and other information the State deems necessary to adequately determine the WHPA.

3. Identifies within each WHPA all potential anthropogenic sources of contaminants which may have any adverse effect on the health of persons.

4. Describes a Program that contains, as appropriate, technical assistance, financial assistance, implementation of control measures, education, training and demonstration projects to protect the water supply within WHPAs from such contaminants.

5. Includes contingency plans for the location and provision of alternate drinking water supplies for each public

water system in the event of well or wellfield contamination by such contaminants.

6. Includes a requirement that consideration be given to all potential sources of such contaminants within the expected wellhead area of a new water well which serves a public water supply system.

7. Includes a requirement for public participation.

Guidance on the content of State Wellhead Protection Programs and the delineation of State Wellhead Protection areas are available from EPA's Office of Groundwater.

EPA believes it can reduce the regulatory burden of the State and public water systems by linking similar program requirements of the WHP program and the Public Water Supply System program under the Safe Drinking Water Act.

Specifically, the 1986 Amendments to the SDWA establish a new Wellhead Protection Program (WHP) to protect ground waters that supply wells and wellfields contributing drinking water to public water supply systems. The Program offers an innovative approach to ground water protection. Unlike most other environmental programs, the WHP Program focuses on the entire resource requiring protection, rather than on a limited set of sources of contamination. The WHP Program, furthermore, focuses on a very important subset of ground water resources; that is, specific areas that supply wells or wellfields withdrawing drinking water for public systems. This focus on public water systems will protect approximately 90 percent of the total amount of ground water used for drinking in the United States. The management of contamination risks to these wells through the WHP Program, therefore, provides the basis for significant gains in human health protection in a focused, effective manner.

Section 1428 of the 1986 SDWA Amendments addresses areas vulnerable to ground water contamination in defining a "wellhead protection area." The Act defines a "wellhead protection area" as "the surface and subsurface area surrounding a water well or wellfield, supplying a public water system, through which contaminants are reasonably likely to move toward and reach such water well or wellfield" (section 1428(e)). Thus, such a water well or wellfield may be vulnerable to contamination because the nature of the surface or subsurface area (i.e., the geology of the area) and the activities in the area are reasonably likely to allow contamination to reach



the well or wellfield. A major factor in reducing vulnerability is a program of management controls for existing and potential sources of contamination. A State Wellhead Protection Program will also include: (1) Contingency plans to respond to contamination of ground water and (2) consideration of sources of contamination in siting new wells. The management of existing and potential sources of contamination, contingency plans, and new well siting is expanded to reduce the vulnerability of public water supply wells.

EPA's Office of Drinking Water is currently in the process of developing guidance on how to evaluate and assess contamination potential which may affect drinking water sources. This guidance will discuss how the assessments conducted under State Wellhead Programs and Drinking Water Programs should be linked.

At this time, EPA is inviting public comment on linking certain requirements of the Wellhead Protection Program and the Public Water Supply System Program. Specifically, EPA would like comment on whether the WHP assessment of sources of contamination could be used for the vulnerability assessment of this proposed rule in determining monitoring frequency of public water supply systems, and what the relationship of the two assessments should be.

## XII. Public Notice Requirements

Under Section 1414(c)(1) of the Act, each owner or operator of a public water system must give notice to persons served by it of (1) any violation of any MCL, treatment technique requirement, or testing provision prescribed by an NPDWR; (2) failure to comply with any monitoring requirement under section 1445(a) of the Act; (3) existence of a variance or exemption; and (4) failure to comply with the requirements of a schedule prescribed pursuant to a variance or exemption. The 1986 amendments require that within 15 months of enactment, EPA amend its current public notification regulations to provide for different types and frequencies of notice based on the differences between violations which are intermittent or infrequent and violations which are continuous or frequent, taking into account the seriousness of any potential adverse health effects which may be involved.

EPA promulgated regulations to revise the public notification requirements on October 28, 1987 (52 FR 41534). The regulations state that violations of an MCL, treatment technique or variance or exemption schedule ("Tier 1 violations") contain health effects language specified

by EPA which concisely and in non-technical terms conveys to the public the adverse health effects that may occur as a result of the violation. States and water utilities remain free to add additional information to each notice, as deemed appropriate for specific situations. This proposed rule contains specific health effects language for the contaminants which are in today's proposed rulemaking. EPA believes that the mandatory health effects language is the most appropriate way to inform the affected public of the health implications of violating a particular EPA standard. The proposed mandatory health effects language in § 141.32(e) describes in non-technical terms the health effects associated with the proposed contaminants. Public comment is requested on the proposed language.

## XIII. Regulatory Impact Analysis

Executive Order 12291 requires EPA and other regulatory agencies to perform a regulatory impact analysis (RIA) for all "major" regulations, which are defined as those regulations which impose an annual cost to the economy of \$100 million or more, or meet other criteria. The Agency has determined that the proposed rule is a major rule for purposes of the Executive Order. This regulation has been reviewed by the Office of Management and Budget as required by the Executive Order and their comments are available in the public docket.

In accordance with the Executive Order, the Agency has conducted an assessment of the benefits and costs of regulatory alternatives (see "Regulatory Impact Analysis of Proposed Inorganic Chemical Regulations," March 31, 1989, and "Regulatory Impact Analysis of Proposed Synthetic Organic Chemical Regulations," April, 1989). The purpose of the assessment was to determine overall impacts of the proposed regulation.

Table 34 shows results from the regulatory impact analyses. Approximately 2,475 community and non-transient, non-community water systems would be expected to exceed the final standards for SOC and IOC without additional treatment. If these systems took actions to comply with the regulations, the annual costs to the nation would be \$88 million.

TABLE 34.—NATIONAL COSTS AND BENEFITS OF PHASE II CONTAMINANTS

	SOCs	IOCs
Central treatment: <sup>1</sup>		
Capital costs (\$M).....	288	73

TABLE 34.—NATIONAL COSTS AND BENEFITS OF PHASE II CONTAMINANTS—Continued

	SOCs	IOCs
Annualized capital (\$M/yr.) <sup>1</sup> .....	19	5
Operating and maintenance costs (\$M/yr.).....	12	6
Annualized monitoring costs (\$M/yr.) <sup>2</sup> .....	<sup>3</sup> 30	<sup>3</sup> 2
State implementation cost.....	14	( <sup>4</sup> )
Total annual costs (\$M/yr.).....	75	13
Number of systems impacted.....	2,283	192
Cancer cases avoided.....	72	( <sup>5</sup> )
Population exposed (millions).....	1.7	0.6
Cost per household per year (\$/hh/yr.) for treatment		
Small.....	125	461
Medium.....	40	126
Large.....	20	72
Very large.....	10	0

<sup>1</sup> Includes waste disposal costs.

<sup>2</sup> Annualized at 3% over 20 years.

<sup>3</sup> Includes the one-time costs for compliance with monitoring requirements for unregulated contaminants.

<sup>4</sup> Included within SOC's.

<sup>5</sup> Because dose/response functions for the sublethal health effects are not available, cancer cases avoided could not be calculated.

The cost impacts on water systems and consumers affected by most of the synthetic organic and inorganic contaminants are small and vary depending upon the specific chemical contaminant and the size of the public water system. Households served by large to very large water systems (those serving more than 3,300 people) could be subject to water bill increases of between \$20 and \$72 per year, if their systems had SOC or IOC contamination greater than the proposed MCLs. EPA believes that these costs are affordable. Small systems, those serving fewer than 500 people, incur higher per household costs because they do not benefit from engineering economies of scale. Households served by these small systems would have to pay significantly more, should their system have SOC or IOC contamination greater than the proposed MCL. In the case of SOC's, typical annual water bills could increase by as much as \$125, which EPA believes is an affordable level. In the case of IOC's, however, water bills in small supplies could climb an additional \$461 per year in contaminated systems. As discussed in Section V, above, EPA is soliciting comment on whether these costs for small systems are affordable in order to determine BAT for small systems under section 1415 of the Act for the purpose of issuing variances.

## A. Regulatory Flexibility Analysis

The Regulatory Flexibility Act requires EPA to consider the effect of regulations on small entities, 5 U.S.C. 602 *et seq.* If there is a significant effect



on a substantial number of small systems, the Agency must prepare a Regulatory Flexibility Analysis which describes significant alternatives which would minimize the impact on small entities. The Administrator has determined that the proposed rule, if promulgated, will not have a significant effect on a substantial number of small entities. Using the Small Business Administration's definition, a small water utility is one that serves fewer than 50,000 people. There are about 78,000 such systems. Of these, fewer than 200 are likely to have contamination levels greater than the inorganics' MCLs and fewer than 2,300 are likely to have contamination in excess of the organic contaminants' MCLs. Therefore, this rule will affect less than one percent of small systems under inorganic MCLs and about 2.9 percent of small systems under the SOC MCLs, which EPA believes does not constitute a substantial number of small systems. It is possible that today's action will have a significant impact on a few small systems if SOCs and IOCs are found at levels higher than the MCLs.

Even though this rule is not subject to the requirements of the Act, the Agency is concerned about potential impacts on small systems and the proposed rule, in many respects, seeks to mitigate that impact. Specifically, the proposed rule allows compositing of samples in order to reduce analytical costs. Also, the Agency has allowed bottled water and point-of-use devices as conditions of receiving a variance or exemption to accommodate the needs of smaller systems with limited resources. The Agency has also given the States the discretion to reduce monitoring frequency in accordance with a system's findings of no SOCs or IOCs and its vulnerability status. Consequently, smaller systems which do not have IOC or SOC contamination in their water supply and are not located in a vulnerable area may have to monitor only infrequently. EPA has also sought to reduce the burden of compliance monitoring by allowing smaller systems more time to complete the initial round of monitoring for VOCs in the proposed rule, and by requiring less frequent monitoring for SOCs for the smallest size systems.

#### B. Paperwork Reduction Act

The information collection requirements in this rule have been submitted for approval to the Office of Management and Budget (OMB) under the Paperwork Reduction Act, 44 U.S.C. 3501 et seq. The information collection requirements are not effective until

OMB approves them and a technical amendment to that effect is published in the Federal Register.

#### XIV. Secondary MCLs (SMCLs)

EPA is proposing SMCLs in this notice based upon taste or odor detection levels for seven organic chemicals. (For five chemicals for which SMCLs are proposed, EPA also is proposing MCLGs/MCLs in this notice). The MCL/MCLGs for an additional SMCL, *p*-dichlorobenzene, was promulgated in the July 8, 1987 Federal Register notice. Seven of these organic chemicals have reported taste or odor detection levels lower than the proposed (or final) MCLs. EPA believes that it is appropriate to set SMCLs for these compounds to protect against aesthetic effects (such as odor) which could be present at levels below the proposed MCLs.

SMCLs are also proposed for two inorganic contaminants, silver and aluminum based on cosmetic and/or aesthetic effects. These contaminants were originally contained in the list of 83 contaminants which were to be regulated by June 19, 1989. However, the Agency substituted other priority contaminants for silver and aluminum (see 53 FR 1892, January 22, 1988).

EPA believes that the nine SMCL contaminants may adversely affect the appearance or odor of drinking water and thereby may cause a substantial number of persons served by the public water system to discontinue their use of its drinking water, or may otherwise affect the public welfare.

For the other chemicals in this notice, EPA would like to develop SMCLs in order to inform the public about expected aesthetic effects (primarily taste and odor) from exposure to a contaminant. However, information on taste or odor detection levels was not available in the literature. EPA asks that any information that may be available on taste or odor detection levels for these chemicals be submitted to the Agency. EPA also plans to carry out studies on taste and odor detection levels for those chemicals for which information is not available in order that SMCLs may be proposed in the future.

EPA determined the SMCLs by evaluating the literature for taste and odor detection levels and, if more than one threshold level was available, using the most conservative (i.e., the lowest) value for that chemical. Literature evaluations included laboratory determinations of taste and odor and thresholds in water dilution calculated from air odor thresholds (a situation which could represent detection of odors in bathing or showering). The

following is a summary of the proposed SMCLs:

#### A. Aluminum

Proposed SMCL of 0.05 mg/l based upon a level recommended by the American Water Works Association (AWWA) to prevent post-treatment precipitation in the distribution system.

#### B. *o*-Dichlorobenzene

Proposed SMCL of 0.01 mg/l, based upon the odor detection level as reported by Kolle, W., K.H. Schweer, N. Gusten and L. Stieglitz (1972). Reference: Identifizierung schwer abbaubaren Schadstoffen in Rhein und Rheinuferfiltrat Vom Wasser, 39, 109-119. (In: *Compilation of Odour Threshold Values in Air and Water*, Circa 1978, Editors, van Gemert, L.J., and A.H. Nettenbreijer, National Institute of Water Supply, Voorburg, Netherlands.)

#### C. *p*-Dichlorobenzene

Proposed SMCL of 0.005 mg/l. The odor detection level as reported by Grunt, F.E.De. (1975) is 0.003 mg/l. Reference: Unpublished data—National Institute for Water Supply, Voorburg, Netherlands. (In: *Compilation of Odour Threshold Values in Air and Water*, Circa 1978, Editors, van Gemert, L.J., and A.H. Nettenbreijer, National Institute of Water Supply, Voorburg, Netherlands.) This level is below the PQL for this compound, which is 0.005 mg/l. Therefore, the Agency is proposing the SMCL for this compound at 0.005 mg/l.

#### D. Ethylbenzene

Proposed SMCL of 0.03 mg/l, rounded from a threshold of 0.029 mg/l in water dilution calculated by J.E. Amore and E. Hautala (1983). Reference: Odor as an Aid to Chemical Safety: Odor Thresholds Compared With Threshold Limit Values and Volatilities for 214 Industrial Chemicals in Air and Water Dilution. *Journal of Applied Toxicology*, 3:6:272-290.

#### E. Pentachlorophenol

Proposed SMCL of 0.03 mg/l, based upon the taste threshold as reported by Dietz, F., and J. Traud. (1978). References: Geruchs-und-Geschmacks-Schwellen-Konzentrationen von Phenolkörpern. Gas-Wasserfach. Wasser-Abwasser. 119:318. In: *Ambient Water Quality Criteria for Pentachlorophenol*, October 1980, EPA 440/580-06.5, Office of Water Regulations and Standards, Washington, D.C.



*F. Silver*

EPA proposes a SMCL of 0.09 mg/l, based upon argyria as a cosmetic effect. The SMCL was determined based upon several clinical reports in which humans developed argyria as a result of i.v. and oral exposure to silver (Gaul and Staud. (1935). *Clinical Spectroscopy*. Seventy Cases of Generalized Argyrosis Following Organic and Colloidal Silver Medication. *J. Am. Med. Assoc.* 104:1387-1390; Blumberg, H., and T.N. Carey. (1934). *Argyria: Detection of Unsuspected and Obscure Argyria by the Spectrographic Demonstration of High Blood Silver*. *J. Am. Med. Assoc.* 103:1521-1524; and East et al. (1980). *Silver Retention, Total Body Silver and Tissue Silver Concentration in Argyria Associated with Exposure in Anti-Smoking Remedy Containing Silver Acetate*. *Clin. Exp. Dermatol.* 5:305-311).

Though EPA proposes the SMCL for silver to remain at 0.09 mg/l based on a skin cosmetic problem called argyria, a different calculation, assuming an oral absorption rate of 4.4 percent and assuming a total accumulation of 1 gram by i.v. would result in a SMCL of 50, 100 or 250 µg/l depending on the selection of an uncertainty factor of 10, 5 or 2. EPA would like the public to comment on these alternatives.

*G. Styrene*

Proposed SMCL of 0.01 mg/l, rounded from a threshold in water dilution of 0.011 mg/l, calculated by J.E. Amoore and E. Hautala (1983). Reference: *Odor as an Aid to Chemical Safety: Odor Thresholds Compared With Threshold Limit Values and Volatilities for 214 Industrial Chemicals in Air and Water Dilution*. *Journal of Applied Toxicology*, 3:6:272-290.

*H. Toluene*

Proposed SMCL of 0.04 mg/l, rounded from a threshold in water dilution of 0.042 mg/l, calculated by J.E. Amoore and E. Hautala (1983). Reference: *Odor as an Aid to Chemical Safety: Odor Thresholds Compared With Threshold Limit Values and Volatilities for 214 Industrial Chemicals in Air and Water Dilution*. *Journal of Applied Toxicology*, 3:6:272-290.

*I. Xylene*

Proposed SMCL of 0.02 mg/l, rounded from a threshold in water dilution of 0.017 mg/l, calculated by J.E. Amoore and E. Hautala (1983). Reference: *Odor as an Aid to Chemical Safety: Odor Thresholds Compared With Threshold Limit Values and Volatilities for 214 Industrial Chemicals in Air and Water*

*Dilution*. *Journal of Applied Toxicology*, 3:6:272-290.

**XV. Proposal To Delete MCL for Silver**

Currently the MCL for silver is 0.05 mg/l (See 40 CFR 141.11(b)). This MCL was established in 1975, as part of the National Interim Primary Drinking Water Regulations. EPA examined the available data on silver and did not propose an RMCL for this compound on November 13, 1985 due to the fact that the only adverse effect from exposure to silver is argyria (a discoloration of the skin). EPA considers argyria a cosmetic effect since it does not impair the functioning of the body or present other physiological problems.

The SDWA Amendments of 1986 require EPA to regulate 83 contaminants in drinking water by 1989. The SDWA allows EPA to substitute up to seven contaminants if regulation of the substitutes is more likely to be protective of public health. EPA has substituted silver from the list of 83 contaminants for regulation (53 FR 1892). Since the effects associated with ingestion of silver are not considered adverse and silver is seldom found at significant levels in water supplies, EPA substituted silver out of the list of 83 contaminants.

EPA is proposing to delete the current MCL for silver, since the effects of ingesting the contaminant are solely cosmetic and not adverse within the meaning of the SDWA. As noted above, EPA is proposing an SMCL for silver based on cosmetic effects. EPA requests public comment on the removal of the silver MCL.

**XVI. Reference and Public Docket**

All supporting materials pertinent to the development of this proposal are included in the Public Docket located at EPA headquarters, Washington, DC. The Public Docket is available for viewing by appointment by calling the telephone number at the beginning of this notice. All public comments received on the 1985 proposal are included in the Docket.

The following references are included in the Public Docket together with other correspondence and information. Additional references are cited throughout the preamble of this proposed rule.

(1) Millette, J.R., P.J. Clark and M.F. Pansing 1979. *Exposure to Asbestos from Drinking Water in the United States*. Cincinnati, OH: Health Effects Research Lab, U.S. EPA. EPA-600/1-79-028.

(2) For each inorganic and organic chemical for which an MCLG is proposed, a health effects criteria

document has been prepared. For example, a typical reference listing would be as follows:

U.S. EPA, Office of Drinking Water, Criteria and Standards Division, Draft Health Effects Criteria Document for Cadmium, September, 1987.

(3) U.S. EPA, EMSL-Cincinnati, Methods Manuals for Organics in Drinking Water, December, 1988.

(4) U.S. EPA, Office of Drinking Water, Office of Program Development and Evaluation, Regulatory Impact Analysis of Proposed Inorganic Chemical Regulations, March, 1989.

(5) U.S. EPA, Office of Drinking Water, Office of Program Development and Evaluation, Regulatory Impact Analysis of Proposed Organic Chemical Regulations, April, 1989.

(6) U.S. EPA, Office of Drinking Water, Criteria and Standards Division, Technologies and Costs for the Treatment and Disposal of Waste By-products from Water Treatments for the Removal of Inorganic and Radioactive Contaminants. Revised draft. September, 1986.

(7) U.S. EPA, Office of Drinking Water, Criteria and Standards Division, Estimated Low Range Costs for the Removal of Inorganics, Radionuclides and Corrosion-Related Contaminants from Potable Water Supplies. Draft. November, 1986.

(8) For each inorganic chemical for which an MCLG is proposed, a Technologies and Costs Document has been prepared. For example, a typical reference listing would be as follows:

U.S. EPA, Office of Drinking Water, Criteria and Standards Division, Technologies and Costs for the Removal of Selenium from Potable Water Supplies. Final draft. November 18, 1985.

(9) U.S. EPA, Office of Drinking Water, Criteria and Standards Division, Technologies and Costs for the Removal of Synthetic Organic Chemicals from Potable Water Supplies. Draft. March, 1989.

(10) For each inorganic chemical for which an MCLG is proposed, a cost supplement document has been prepared. For example, a typical reference listing would be as follows:

U.S. EPA, Office of Drinking Water, Criteria and Standards Division, Cost Supplement to Technologies and Costs for the Removal of Selenium from Potable Water Supplies. Draft. February 13, 1987.

**XVII. Request for Public Comment**

EPA requests public analysis, comments and information on all aspects of this proposal. In addition to



the questions noted earlier, we are also soliciting comment for the following:

- Do the MCLGs which have been changed since the November 1985 notice represent a level such that "no known or anticipated adverse effect would result with an adequate margin of safety?"

- Do the MCLs represent a level as close to the MCLGs as feasible?

- Is the methodology for determining the MCLs appropriate?

- Are the levels set for the MCLs feasible?

- Are the costs of meeting the MCLs reasonable?

- Should the Agency consider other technologies as BAT in addition to the proposed BATs?

- Is the approach used to determine the treatment technique for acrylamide and epichlorohydrin reasonable?

- Are the technologies proposed as BAT (Section 1415 variances) appropriate?

- Are the proposed performance requirements reasonable for the purposes of determining laboratory approval?

- Does the proposed mandatory health effects information for the public notification requirements represent a clear statement of the potential health effects of the chemicals?

- Do the proposed compliance monitoring requirements serve the purpose of ensuring that high quality water is available?

- Is the proposal for monitoring for unregulated contaminants reasonable?

- Do the proposed SMCLs protect against aesthetic effects? Is there additional taste and odor data that could be used to set SMCLs for other chemicals in this notice?

- Are there alternative monitoring requirements which would still ensure high quality water but which would be less burdensome for water systems and States?

#### Appendix A. 83 Contaminants required to be regulated under the SDWA of 1986

##### Volatile Organic Chemicals

Trichloroethylene	Benzene
Tetrachloroethylene	Chlorobenzene
Carbon tetrachloride	Dichlorobenzene
1,1,1-Trichloroethane	Trichlorobenzene
1,2-Dichloroethane	1,1-Dichloroethylene
Vinyl chloride	trans-1,2-Dichloroethylene
Methylene chloride	cis-1,2-Dichloroethylene

##### Microbiology and Turbidity

Total coliforms	Viruses
Turbidity	Standard plate count
<i>Giardia lamblia</i>	<i>Legionella</i>

##### Inorganics

Barium	Molybdenum
Cadmium	Asbestos
Chromium	Sulfate
Lead	Copper
Mercury	Vanadium
Nitrate	Sodium
Selenium	Nickel
Silver	Zinc
Fluoride	Thallium
Aluminum	Beryllium
Antimony	Cyanide

##### Organics

Endrin	1,1,2-Trichloroethane
Lindane	Vydate
Methoxychlor	Simazine
Toxaphene	PAHs
2,4-D	PCBs
2,4,5-TP	Atrazine
Aldicarb	Phthalates
Chlordane	Acrylamide
Dalapon	Dibromochloropropane (DBCP)
Diquat	1,2-Dichloropropane
Endothal	Pentachlorophenol
Glyphosate	Picloram
Carbofuran	Dinoseb
Alachlor	Ethylene dibromide (EDB)
Epichlorohydrin	Dibromomethane
Toluene	Xylene
Adipates	Hexachlorocyclopentadiene

##### 2,3,7,8-TCDD (Dioxin)

##### Radionuclides

Radium 226 and 228	Gross alpha particle activity
Beta particle and photon radioactivity	Radon
Uranium	

#### Appendix B.—Guidance to Determine Vulnerability of Public Water Systems to Contamination by Pesticides

EPA has reviewed existing information and scientific knowledge about the extent of pesticide contamination, its causes, and its potential health impacts via drinking water consumption. Recent monitoring efforts by some States indicate that the number of pesticides found in ground water is significant enough to cause concern. However most pesticides are generally found at low levels. Most of the available monitoring data is the result of studies conducted in "hot-spot" areas or in wells not used for drinking water consumption. Therefore, the available occurrence information is inadequate to make national projections of consumer exposure to pesticides via drinking water. Currently EPA is surveying public and private wells via a pesticide survey and may be able to use this data to determine national occurrence at a later date.

There are five general criteria that can be used to target those systems which appear to have the greatest vulnerability to pesticide contamination. These criteria can aid the States in the

development and implementation of monitoring programs that would focus monitoring efforts on those systems most vulnerable to contamination by pesticides. These criteria are:

- (1) Available monitoring data on pesticides or other synthetic organic compounds,

- (2) The nearby presence of potential sources of contamination,

- (3) Environmental persistence of the pesticide and mobility of the contaminant,

- (4) The hydrogeological conditions in the area, and

- (5) The finding of elevated nitrate levels in the water supply.

The best indicator that a system is vulnerable to pesticide contamination is prior, reliable occurrence data. The second criterion, nearby use, storage or disposal of pesticides, is an obvious indication of potential contamination, provided the pesticide can infiltrate the water supply. This phenomenon encompasses the third and fourth criteria, which depend on the environmental persistence of the contaminant and the vulnerability to infiltration of the water source. The latter is a complex function of the local climate, geology, and hydrology of the water source.

The EPA has postulated the fifth criterion, elevated nitrate levels, as an indicator of pesticide infiltration. Since nitrates in water are an indication that fertilizer (man made or animal droppings) has leached into the water source, it also indicates that environmentally stable, water transported pesticides could contaminate the same source. It appears that there is a positive correlation between high nitrate levels and the presence of other contaminants. Unfortunately, like many simple indicators, it only flags contaminated supplies. The absence of higher than normal nitrate levels does not seem to indicate that a supply is invulnerable or uncontaminated. However, EPA encourages authorities to consider this as a possible, facile way to select hot spots for more thorough pesticide screening.

The first four criteria are discussed in more detail below.

##### 1. Previous Findings

The identification of contamination by pesticides or other synthetic organic compounds during previous monitoring efforts suggests that the recharge area is vulnerable. This occurs in locations where the recharge areas are close to the land surface and thus may be affected by land management practices



such as pesticide application. Water supplies are contaminated either through a transport of the chemicals through the soil to the ground water, or in the case of surface waters, through surface run-off. Positive results are always helpful in identifying areas conducive to chemical residue transport.

## 2. Proximity to Sources of Contamination

Pesticides may contaminate a vulnerable water source during their manufacture, distribution, storage, disposal, or use. They may be used on the land or in industrial settings. The sources of contamination may be grouped into two general categories based on the characteristics of the contamination:

a. *Point sources*—include spills and leaks of pesticides at manufacturing, distribution or storage facilities, or from hazardous and municipal waste landfills and other waste handling or treatment facilities where bulk pesticides are disposed. There are a number of Federal and state laws that are aimed at the prevention and reporting of spills and leaks from these facilities. When an accident does occur, it is relatively localized and can be at least partially controlled. Reports of these incidents can aid in assessing the vulnerability of a supply.

b. *Non-point sources*—include use of pesticides to control insect and weed

pests on agricultural areas, forest lands, home and gardens, and other land application uses. The pesticides applied to the land may be carried by runoff waters into surface water or may enter ground water by infiltration through the ground.

For surface water systems, the proximity of the water sources to manufacturers and formulators increases the probability of contamination because of potential discharges into the surface water. The potential for contamination of the water source also increases with the proximity to agricultural areas because of runoff of pesticides into surface water. Thus, a sanitary survey and an examination of upstream waste water discharges and agricultural activities can indicate the nature and extent of pollution activities that affect the vulnerability of a surface water system. Some watersheds are protected by strict access and land use laws. Surface water systems could be ranked according to the extent of watershed protection afforded by these land use restrictions or the remoteness of the source to pesticide manufacturing or use activities.

Table B-1 summarizes potential sources of contamination of ground water sources. States should determine the presence of manufacturing, commercial, or waste disposal facilities, or other potential point sources near the recharge areas. The presence of

contamination from agricultural use or other land uses is more difficult to assess because such usage is often spread over a wide area at very low concentrations initially that may build up over time with continued pesticide use.

States may establish a hierarchy that would characterize regions according to whether they have high, medium, low or uncommon pesticide usage for land application uses. Specific information on use patterns may be obtained from the agricultural commissioner or other local authorities. Also, regional pesticide sales data and county level crop data are available. Table B-2 summarizes the major current applications of selected pesticides. These tools can be used by States to set monitoring priorities for water systems.

The use of 2,4,5-TP (Silvex) was cancelled in 1984. In addition, toxaphene was apparently used only in cotton growing areas since 1984 when its use was cancelled for most other crops. More recently, the use of chlordane and heptachlor was cancelled in 1988. The use of EDB and DBCP has also been severely restricted. Water supplies that do not detect the presence of these contaminants during initial monitoring should not be required to conduct repeat monitoring. States may want to reclassify the vulnerability of the system based upon the initial monitoring results.

TABLE B-1.—POTENTIAL SOURCES OF PESTICIDE CONTAMINATION OF GROUND WATER

	Manufacturers/ Formulators	Dealer	Industrial user	Land application
Spills and Leaks				
Storage Areas.....	X	X	X	X
Storage Tanks/Pipelines.....	X	X	X	
Loading/Unloading.....	X	X	X	X
Transport Accidents.....	X	X	X	X
Disposal				
Process Waste.....	X		X	
Off-specification Material.....	X			
Cancelled Products.....	X	X	X	X
Containers.....	X	X	X	X
Rinsate.....				X
Land Application				
Leaching <sup>1</sup> .....				X
Backflow to irrigation well.....				X
Run-in to wells, sinkholes.....				X
Mixing/loading areas.....				X

<sup>1</sup> Leaching potential affected by chemical-physical properties of pesticide, hydrogeologic setting, and application and cultivation practices. Reference: Pesticides in Ground Water. Background Document U.S. EPA, Office of Ground Water Protection, May 1986.



TABLE B-2.—CURRENT APPLICATIONS OF SELECTED PESTICIDES

Pesticide	Applications <sup>1</sup>
Alachlor .....	Corn; soybeans; peanuts.
Aldicarb .....	White/sweet potatoes; cotton; peanuts; pecans (S.E.); citrus; sugar beets; ornamentals; dry beans; sorghum; soybeans; sugarcane (La.).
Carbofuran .....	Sweet/field corn; sorghum; alfalfa; peanuts; soybeans; rice; grapes; cotton; sugarcane; tobacco; potatoes; grapes; small grains; cucurbits.
Chlordane .....	Cancelled, 1988.
2,4-D .....	Grasses; wheat; barley; oats; sorghum; corn; sugarcane.
DBCP .....	Pineapples (Hawaii only).
1,2-Dichloropropane .....	Soil fumigant.
EDB .....	Fumigation of exported fruit.
Heptachlor .....	Cancelled, 1988.
Lindane .....	Seed and soil treatment; lumber dips; fruit and nut tree foliage application; vegetables; human scalp (lice); ornamentals; tobacco transplants.
Methoxychlor .....	Dairy and beef cattle; home gardens; fruit and shade trees; vegetables.
Pentachlorophenol .....	Wood preservative.
2,4,5-TP (Silvex) .....	Cancelled, 1984.
Toxaphene .....	Cotton; cancelled for other uses, 1984.

<sup>1</sup> Berg, G.L., ed., Farm Chemicals Handbook, 1986.

In summary, the following information should be considered in the determination of proximity of the water system to potential sources of contamination:

- a. Nearby manufacturing, distribution or storage facilities;
- b. Nearby hazardous and municipal waste landfills or other waste handling or treatment facilities;
- c. Nearby land application uses, especially in crop growing areas; and
- d. Reports of spills or leaking storage areas.

### 3. Environmental Persistence

In general, the ability of a pesticide to reach groundwater increases with its environmental persistence. Many organochlorine pesticides have been banned because of their long persistence in the environment. The disappearance of a pesticide from soil can be the result of physical, chemical and biological processes. These processes include volatilization, hydrolysis, photolysis and microbial degradation. Degradation of pesticides can be expressed as field dissipation half-lives or as persistence in soil (i.e., approximate time for 90% disappearance from soil). The decomposition processes are in turn a function of the climate (humidity, temperature, rainfall) and the soil type.

The combination of pesticide degradation rates and the hydrogeological characteristics of the area determine whether the pesticide has the opportunity to contaminate the water source.

### 4. Vulnerable Hydrogeology

Certain hydrogeological characteristics influence the likelihood that a pesticide will infiltrate through the soil and contaminate ground water sources. Hydrogeological factors such as type of soil, depth to water, and permeability of the aquifer formation can determine the vulnerability of a ground water source to pesticide contamination. There are various approaches that have been evaluated for modeling ground water vulnerability from the knowledge of hydrogeological parameters. One of these approaches, known by the acronym DRASTIC, combines information on seven different hydrogeological parameters to produce a score which is an indicator of relative ground water contamination potential for a county or subcounty region.

DRASTIC has been used by EPA to classify all the counties of the United States into three categories of ground water vulnerability (high, medium or low) as part of the design of National Pesticide Survey. States may use DRASTIC or other approaches in combination with pesticide use data to determine those areas particularly vulnerable to pesticide contamination. Specific hydrogeologic considerations of DRASTIC are:

a. *Depth to water*—it determines the thickness of the material through which a contaminant must travel to reach the aquifer (shallow ground water depths are more vulnerable than deeper ground water depths).

b. *Recharge*—amount of water per unit area of land that reaches the water table (the greater the recharge, the easier it is for contamination to occur).

c. *Aquifer media*—geological materials that exert control over the route and path length that a contaminant must follow (the larger the grain size or porosity and the more fractures within the aquifer, the higher permeability, and the greater the contamination potential).

d. *Soil type*—it affects the amount of recharge that can infiltrate into ground water and the ability of a contaminant to move vertically (highly permeable soils increase contamination potential).

e. *Topography*—it refers to the slope of the land surface (steep slopes are more conducive to high runoff capacity, rapid erosion and contamination of surface waters and provide less

probability of infiltration into ground water).

f. *Vadose zone media*—it refers to the water-saturated zone above the water table which controls the path-length and routing of contamination (similar to aquifer media).

g. *Hydraulic conductivity*—it refers to the ability of the aquifer material to transmit pollutants throughout the aquifer.

The source of water may be protected by natural factors such as the hydrogeologic characteristics described above, or regulatory discharge controls. However, other conditions may arise that could lead to contamination problems. For example, even geologically invulnerable formations can be polluted by improper well construction or discharging into existing wells. Also, areas with cool, moist climates, where evaporation is low and rainfall is high are likely to be conducive to pesticide transport to ground water, particularly where such conditions exist during or shortly after application.

Irrigation practices may also facilitate contaminant movement. For surface water sources, a sanitary survey and an examination of upstream waste dischargers or agricultural runoff can indicate the extent of pollution activities that affect the vulnerability of surface water systems. Contamination of surface water systems from agricultural runoff is influenced by the timing of rainfall events after application.

The above criteria may be used by individual states to determine the vulnerability of public water systems to contamination by pesticides.

### List of Subjects in 40 CFR Parts 141, 142 and 143

Chemicals, Reporting and recordkeeping requirements, Water supply, Administrative practice and procedure.

William K. Reilly,  
Administrator, Environmental Protection Agency.

Date: April 27, 1989.

For the reasons set forth in the preamble, Title 40 of the Code of Federal Regulations is proposed to be amended as follows:

### PART 141—NATIONAL PRIMARY DRINKING WATER REGULATIONS

1. The authority citation for Part 141 continues to read as follows:

Authority: 42 U.S.C. 300g-1, 300g-3, 300g-6, 300j-4 and 300j-9.

2. In § 141.11, paragraph (b) is amended by removing the entry for



"silver" from the table, and by revising the text of paragraph (b) preceding the table to read as follows:

**§ 141.11 Maximum contaminant levels for inorganic chemicals.**

(b) The following maximum contaminant levels for barium, cadmium, chromium, mercury, nitrate, and selenium shall remain effective until [insert date 18 months after publication of final rule in the Federal Register].

3. Section 141.23, is revised to read as follows:

**§ 141.23 Inorganic chemical sampling and analytical requirements.**

Community water systems shall conduct monitoring to determine compliance with the maximum contaminant levels specified in § 141.11 or 141.62 (as appropriate) in accordance with this section. Non-transient, non-community water systems shall conduct monitoring to determine compliance with the maximum contaminant levels in § 142.62 in accordance with this section. Transient, non-community water systems shall conduct monitoring to determine compliance with the nitrate and nitrite maximum contaminant levels in § 141.11 and § 141.62 (as appropriate) in accordance with this section.

(a) Monitoring shall be conducted as follows:

(1) Groundwater systems shall take a minimum of one sample at every entry point to the distribution system which is representative of each well after treatment (hereafter called a sampling point). The system shall take each sample at the same sampling point unless conditions make another sampling point more representative of each source or treatment plant.

(2) Surface water systems shall take a minimum of one sample at every entry point to the distribution system after any application of treatment or in the distribution system at a point which is representative of each source after treatment (hereafter called a sampling point). The system shall take each sample at the same sampling point unless conditions make another sampling point more representative of each source or treatment plant.

(3) If a system draws water from more than one source and the sources are combined before distribution, the system must sample at an entry point to the distribution system during periods of normal operating conditions (i.e., when water is representative of all sources being used).

(4) The State may reduce the total number of samples which must be

analyzed by allowing the use of compositing. Composite samples from a maximum of five sampling points are allowed. Compositing of samples must be done in the laboratory. If the concentration in the composite sample indicates contamination by one or more inorganic chemicals, then a follow-up sample must be taken at each sampling point included in the composite and analyzed for the contaminants which were present in the composite sample within 14 days.

(5) The frequency of monitoring for barium, cadmium, chromium, fluoride, mercury, and selenium shall be in accordance with paragraph (c) of this section, the frequency of monitoring for asbestos shall be in accordance with paragraph (d) of this section; the frequency of monitoring for nitrate and nitrite shall be in accordance with paragraph (e) of this section.

(b) Monitoring conducted to determine compliance with the maximum contaminant level for asbestos specified in § 141.62 shall be conducted as follows:

(1) No community or non-transient, non-community water system is required to monitor for asbestos unless the State determines the system is vulnerable, to asbestos contamination in its source water or due to corrosion of asbestos-cement pipe, or both. The State shall make this determination by [insert date 18 months from publication of the final rule in the Federal Register], based on a consideration of the following factors:

(i) Potential asbestos contamination of the water source,

(ii) The use of asbestos-cement pipe for finished water distribution and the corrosive nature of the water.

(2) If the system is determined by the State in accordance with paragraph (b)(1) of this section to be vulnerable to asbestos contamination in its source water, the system shall monitor in accordance with the provisions of paragraph (a) of this section.

(3) If the system is determined by the State in accordance with paragraph (b)(1) of this section to be vulnerable to asbestos contamination due to corrosion of asbestos-cement pipe, the system shall take one sample at a tap served by asbestos-cement pipe and under conditions where asbestos contamination is most likely to occur.

(4) If the system is determined by the State in accordance with paragraph (b)(1) of this section to be vulnerable to asbestos contamination both in its raw water supply and due to corrosion of asbestos-cement pipe, the system shall take one sample at a tap served by asbestos-cement pipe and under

conditions where asbestos contamination is most likely to occur.

(5) Systems designated as vulnerable to asbestos contamination may be redesignated by the State as not vulnerable based upon the results of initial monitoring and a revised assessment that it is not vulnerable to asbestos contamination.

(c) The frequency of monitoring conducted to determine compliance with the maximum contaminant levels in §§ 141.11 or 141.62 (as appropriate) for barium, cadmium, chromium, fluoride, mercury, and selenium shall be as follows:

(1) Groundwater systems shall monitor once every three years and surface water systems shall monitor once every year.

(2) The State may reduce the three year and one year monitoring frequencies specified in paragraph (c)(1) of this section to no less than once every ten years provided that surface water systems have monitored annually for at least three years and that groundwater systems have conducted a minimum of three rounds of monitoring and all previous analytical results are <50 percent of the maximum contaminant level. Systems that use a new water source are not eligible for reduced monitoring until three rounds of monitoring from the new source have been completed. In determining the appropriate reduced monitoring frequency, the State shall consider:

(i) Reported concentrations from all previous monitoring;

(ii) The degree of variation in reported concentrations; and

(iii) Other factors which may affect contaminant concentrations such as changes in groundwater pumping rates, changes in the system's configuration, changes in the system's operating procedures, or changes in stream flows or characteristics.

(3) A decision by the State to reduce the monitoring frequency shall be made in writing and shall set forth the basis for the determination. The determination may be initiated by the State or upon an application by the public water system. The public water system shall specify the basis for its request. The State shall review and, where appropriate, revise its determination of the appropriate monitoring frequency when the system submits new monitoring data or when other data relevant to the system's appropriate monitoring frequency becomes available.

(4) Each community water system shall complete the first round of monitoring required by paragraph (c)(1) of this section and report the results to



the State by [insert 18 months after publication of this final rule in the Federal Register].

(5) Each non-transient, non-community water system shall complete the first round of monitoring required by paragraph (c)(1) of this section and report the results to the State by [insert four years after publication of this final rule in the Federal Register].

(d) Each community and non-transient, non-community water system determined by the State in accordance with paragraph (b)(1) of this section to be vulnerable to asbestos contamination shall conduct one round of monitoring and report the results to the State by [insert five years from publication of this final rule in the Federal Register].

(1) For those systems where the level of asbestos in any sample in the initial round of monitoring is  $\geq 50$  percent of the MCL for asbestos, monitoring for ground water systems shall be repeated every three years and monitoring for surface water systems shall be repeated every year.

(2) For those systems where the level of asbestos in each sample in the initial round of monitoring is  $\geq 50$  percent of the MCL for asbestos, the State shall determine whether repeat monitoring is required and, if so, the frequency of such monitoring.

(e) Each community, non-transient, non-community; and transient, non-community water system shall monitor to determine compliance with the maximum contaminant level for nitrate in § 141.11 or § 141.62(b) (as appropriate) and for nitrite in § 141.62(b).

(1) Community and non-transient, non-community water systems served by ground water systems shall monitor annually; systems served by surface water shall monitor quarterly.

(2) For community and non-transient, non-community water systems, the repeat monitoring frequency for ground water systems shall be quarterly for at least one year following any one sample in which the concentration is  $\geq 50$  percent of the MCL. The State may allow a ground water system to reduce the sampling frequency to annually after four consecutive quarterly samples are  $< 50$  percent of the MCL.

(3) For community and non-transient, non-community water systems, the State may allow a surface water system to reduce the sampling frequency to annually if all analytical results from four consecutive quarters are  $< 50$  percent of the MCL. A surface water system shall return to quarterly

monitoring if any one sample is  $\geq 50$  percent of the MCL.

(4) Each transient non-community water system served by groundwater shall monitor for nitrate and nitrite every three years. Each non-community water system served by surface water shall monitor for nitrate and nitrite annually.

(5) Each sample must be taken at the time of highest vulnerability to nitrate/nitrite contamination (i.e., after rain and/or application of fertilizer).

(6) Each community water system shall complete the initial monitoring required by paragraph (e)(1) of this section (as appropriate) and report the results to the State by [insert 18 months after publication of this final rule in the Federal Register].

(7) Each non-transient, non-community water system shall complete the initial monitoring required by paragraph (e)(1) of this section and report the results to the State by [insert 4 years after publication of this final rule in the Federal Register].

(8) Each transient non-community water system shall complete the initial monitoring required by paragraph (e)(4) of this section and report the results to the State by [insert 4 years after publication of this final rule in the Federal Register].

(f) Confirmation samples:

(1) Where the results of sampling for asbestos, barium, cadmium, chromium, fluoride, mercury, or selenium indicate an exceedance of the maximum contaminant level, the State may require that one additional sample be collected as soon as possible after the initial sample was taken (but not to exceed two weeks) at the same sampling point.

(2) Where nitrate or nitrite sampling results indicate an exceedance of the maximum contaminant level, the system shall take a confirmation sample within 24 hours of the system's receipt of notification of the analytical results of the first sample. Both samples must be analyzed and the results reported to the State within two weeks of the initial sampling.

(3) If a confirmation sample is taken for any contaminant, then the results of the initial and confirmation sample shall be averaged. The resulting average shall be used to determine the system's compliance in accordance with paragraph (h) of this section. States have the discretion to delete results of obvious sampling errors.

(g) The State may require more frequent monitoring than specified in paragraphs (b), (c), (d) and (e) of this

section or may require confirmation samples for positive and negative results at its discretion.

(h) Compliance with § 141.11 or 141.62(b) (as appropriate) shall be determined based on the analytical result obtained at each sampling point.

(1) For systems which are conducting quarterly monitoring, compliance with the maximum contaminant levels for asbestos, barium, cadmium, chromium, fluoride, mercury, and selenium is determined by a running annual average at each sampling point. If the average at any sampling point is greater than the MCL, then the system is out of compliance. If any one sample would cause the annual average to be exceeded, then the system is out of compliance immediately.

(2) For systems which are monitoring annually, or less frequently, the system is out of compliance with the maximum contaminant levels for asbestos, barium, cadmium, chromium, fluoride, mercury and selenium if the level of a contaminant at any sampling point is greater than the MCL. If a confirmation sample is required by the State, the determination of compliance will be based on the average of the two samples.

(3) Compliance with the maximum contaminant levels for nitrate and nitrite is determined based on one sample if the levels of these contaminants is below the MCL. If the levels of nitrate or nitrite exceed the MCLs in the initial sample, a confirmation sample is required in accordance with paragraph (f)(2) of this section, and compliance shall be determined based on the average of the initial and confirmation samples.

(4) If a public water system has a distribution system separable from other parts of the distribution system with no interconnections, only that part of the system that exceeds the MCL as specified in § 141.11 or 141.62(b) (as appropriate) will be out of compliance. The State may allow the system to give public notice to only that portion of the system which is out of compliance.

(i) The State has the authority to determine compliance or initiate enforcement action based upon analytical results and other information compiled by their sanctioned representatives and agencies.

(j) Inorganic analysis:

(1) Analysis for asbestos, barium, cadmium, chromium, mercury, nitrate, nitrite, and selenium shall be conducted using the following methods:



## METHODOLOGY FOR INORGANIC CONTAMINANTS

Contaminant	Methodology <sup>11</sup>	EPA <sup>1</sup>	Reference (Method Number)		
			ASTM <sup>2</sup>	SM <sup>3</sup>	Other
Asbestos.....	Transmission electron microscopy.....	EPA <sup>9</sup>			
Barium.....	Graphite furnace Atomic absorption; technique <sup>a</sup> .....	208.2		304	
	Atomic absorption; direct aspiration <sup>b</sup> .....	208.1		303C	
	Inductively-coupled plasma-Atomic emission <sup>c</sup> .....	200.7A <sup>6</sup>			
Cadmium.....	Graphite furnace Atomic absorption; technique.....	213.2		304	
	Inductively-coupled plasma <sup>c</sup> .....	200.7A <sup>6</sup>			
Chromium.....	Atomic absorption; furnace technique <sup>a</sup> .....	218.2		304 <sup>7</sup>	
	Atomic absorption; direct aspiration <sup>b</sup> .....	218.1	D1687-84D	303A or B	
	Inductively-coupled plasma <sup>c</sup> .....	200.7A <sup>6</sup>			
Mercury.....	Manual cold vapor technique.....	245.1	D3223-80	303F	
	Automated cold vapor technique.....	245.2			
Nitrate.....	Manual cadmium reduction.....	353.3	D3867-85B	481C	
	Automated hydrazine reduction.....	353.1			
	Automated cadmium reduction.....	353.2	D3867-85A	418F	
	Ion selective electrode.....				WeWWG/ 5880 <sup>8</sup> B-1011 <sup>10</sup>
Nitrite.....	Ion chromatography.....	300.0			
	Spectrophotometric.....	354.1			
	Automated cadmium reduction.....	353.2	D3867-85A	418F	
	Manual cadmium reduction.....	353.3	D3867-85B	418C	
	Ion chromatography.....	300.0			B-1011 <sup>10</sup>
Selenium.....	Atomic absorption; gaseous hydride.....	270.3	D3859-84A	303E	I-3667-85 <sup>4</sup>
	Atomic absorption; furnace <sup>a</sup> .....	270.2	D3859-84B	304 <sup>8</sup>	

<sup>a</sup> Graphite furnace Atomic Absorption Spectroscopy (GFAA).

<sup>b</sup> Direct Aspiration Atomic Absorption Spectroscopy (AA).

<sup>c</sup> Inductively Coupled Plasma Atomic Emission Spectroscopy (ICP-AES).

<sup>1</sup> "Methods of Chemical Analysis of Water and Wastes," EPA Environmental Monitoring and Support Laboratory, Cincinnati, OH 45268 (EPA-600/4-79-020), March 1983. Available from ORD Publications, CERL, EPA, Cincinnati, OH 45268.

<sup>2</sup> Annual Book of ASTM Standards, Vol. 11.01 American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

<sup>3</sup> "Standard Methods for the Examination of Water and Wastewater," 16th edition, American Public Health Association, American Water Works Association, Water Pollution Control Federation, 1985.

<sup>4</sup> "Methods for Determination of Inorganic Substances in Water and Fluvial Sediments," Techniques of Water-Resources Investigations of the U.S. Geological Survey Books, Chapter A1, 1985, Open-File Report 85-495. Available from Open-File Services Section, Western Distribution Branch, U.S. Geological Survey, MS 306 Box 24525, Denver Federal Center, Denver, CO 80225.

<sup>5</sup> "Orion Guide to Water and Wastewater Analysis," Form WeWWG/5880, p. 5, 1985. Orion Research, Inc., Cambridge, MA.

<sup>6</sup> "Inductively-Coupled Plasma Atomic Emission Analysis of Drinking Water," Appendix to Method 200.7, March 1987, U.S. EPA, Environmental Monitoring and Support Laboratory, Cincinnati, OH 45268.

<sup>7</sup> The addition of 1 mL of 30% H<sub>2</sub>O<sub>2</sub> to each 100 mL of standards and samples is required before analysis.

<sup>8</sup> Prior to dilution of the Se calibration standards, add 2 mL of 30% H<sub>2</sub>O<sub>2</sub> for each 100 mL of standard.

<sup>9</sup> "Analytical Method for Determination of Asbestos Fibers in Water," EPA-600/4-83-043, September 1983, U.S. EPA, Environmental Research Laboratory, Athens, GA 30613.

<sup>10</sup> "Waters Test Method for the Determination of Nitrite and Nitrate in Water Using Single Column Ion Chromatography, Method B-1011, Millipore Corporation, Waters Chromatography Division, 34 Maple Street, Milford, MA 01757.

<sup>11</sup> For approved analytical procedures for metals, the technique applicable to total metals must be used.

(2) Analyses for arsenic shall be conducted using the following methods:

Method <sup>1</sup> 206.2, Atomic Absorption Furnace Technique; or Method <sup>1</sup> 206.3, or Method <sup>4</sup> D2972-78B, or Method <sup>2</sup>

301.A VII, pp. 159-162, or Method <sup>3</sup> I-1062-78, pp. 61-63, Atomic Absorption—Gaseous Hydride; or Method <sup>1</sup> 206.4, or Method <sup>4</sup> D-2972-78A, or Method <sup>12</sup>

404-A and 404-B(4), Spectrophotometric, Silver Diethyl-dithiocarbamate.

(3) Analyses for fluoride shall be conducted using the following methods:

## METHODOLOGY FOR FLUORIDE

Methodology	Reference (method number)			
	EPA <sup>1</sup>	ASTM <sup>4</sup>	SM <sup>5</sup>	Other
Colorimetric SPADNS, with distillation.....	340.1	D1179-72A	43 A and C	
Potentiometric ion selective electrode.....	340.2	D1179-72B	413 B	
Automated alizarin fluoride blue, with distillation (complexone).....	340.3		413 E	129-71W <sup>6</sup>
Automated ion selective electrode.....				380-75WE <sup>7</sup>

<sup>1</sup> "Methods of Chemical Analysis of Water and Wastes," EPA Environmental Monitoring and Support Laboratory, Cincinnati, Ohio 45268 (EPA-600/4-79-020), March 1979. Available from ORD Publications, CERL, EPA, Cincinnati, Ohio 45268. For approved analytical procedures for metals, the technique applicable to total metals must be used.

<sup>1</sup> "Methods of Chemical Analysis of Water and Wastes," EPA Environmental Monitoring and Support Laboratory, Cincinnati, Ohio 45268 (EPA-600/4-79-020), March 1979. Available from ORD Publications, CERL, EPA, Cincinnati, Ohio 45268. For approved analytical procedures for metals, the technique applicable to total metals must be used.

<sup>2</sup> "Standard Methods for the Examination of Water and Wastewater," 14th Edition, American Public Health Association, American Water Works Association, Water Pollution Control Federation, 1976.

<sup>3</sup> Techniques of Water-Resources Investigation of the United States Geological Survey, Chapter A-1, "Methods for Determination of Inorganic

Substances in Water and Fluvial Sediments," Book 5, 1979, Stock #014-001-03177-9. Available from Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

<sup>4</sup> Annual Book of ASTM Standards, part 31 Water, American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.



<sup>2</sup> [Reserved]

<sup>3</sup> [Reserved]

<sup>4</sup> Annual Book of ASTM Standards, part 31 Water. American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.

<sup>5</sup> "Standard Methods for the Examination of Water and Wastewater," 16th Edition, American Public Health Association, American Water Works Association, Water Pollution Control Federation, 1985.

<sup>6</sup> "Fluoride in Water and Wastewater, Industrial Method = 129-71W." Technicon Industrial Systems, Tarrytown, New York, 10591. December 1972.

<sup>7</sup> "Fluoride in Water and Wastewater," Technicon Industrial Systems, Tarrytown, New York, 10591. February 1976.

(4) Sample collection for asbestos, barium, cadmium, chromium, fluoride, mercury, nitrate, nitrite, and selenium

under this section shall be conducted using the sample preservation,

container, and maximum holding time procedures specified in the table below:

Contaminant	Preservative <sup>1</sup>	Container <sup>2</sup>	Maximum holding time <sup>3</sup>
Asbestos.....	Cool, 4 °C.....	P or G.....	
Barium.....	Conc HNO <sub>3</sub> to pH <2.....	P or G.....	6 months.
Cadmium.....	Conc HNO <sub>3</sub> to pH <2.....	P or G.....	6 months.
Chromium.....	Conc HNO <sub>3</sub> to pH <2.....	P or G.....	6 months.
Fluoride.....	None.....	P or G.....	1 month.
Mercury.....	Conc HNO <sub>3</sub> to pH <2.....	G.....	38 days.
Nitrate.....		P.....	14 days.
Chlorinated.....	Cool, 4 °C.....	P or G.....	28 days.
Non-chlorinated.....	Conc H <sub>2</sub> SO <sub>4</sub> to pH <2.....	P or G.....	14 days.
Nitrite.....	Cool, 4 °C.....	P or G.....	48 hours.
Selenium.....	Conc HNO <sub>3</sub> to pH <2.....	P or G.....	6 months.

<sup>1</sup> If HNO<sub>3</sub> cannot be used because of shipping restrictions, sample may be initially preserved by icing and immediately shipping it to the laboratory. Upon receipt in the laboratory, the sample must be acidified with conc HNO<sub>3</sub> to pH <2. At time of analysis, sample container should be thoroughly rinsed with 1:1 HNO<sub>3</sub>; washings should be added to sample.

<sup>2</sup> P=plastic, hard or soft; G=glass, hard or soft.

<sup>3</sup> In all cases, samples should be analyzed as soon after collection as possible.

(5) Analysis under this section shall only be conducted by laboratories that have received approval by EPA or the State. To receive approval to conduct analyses for asbestos, barium, cadmium, chromium, fluoride, mercury, nitrate, nitrite and selenium the laboratory must:

(i) Analyze Performance Evaluation samples which include those substances provided by EPA Environmental Monitoring and Support Laboratory or equivalent samples provided by the State.

(ii) Achieve quantitative results on the analyses that are within the following acceptance limits:

Contaminant	Acceptance limit
Asbestos.....	2 standard deviations based on study statistics.
Barium.....	±15% at >0.15 mg/l.
Cadmium.....	±20% at >0.002 mg/l.
Chromium.....	±15% at >0.01 mg/l.
Fluoride.....	±10% at 1 to 10 mg/l.
Mercury.....	±30% at >0.0005 mg/l.
Nitrate.....	±10% at >0.4 mg/l.
Nitrite.....	±10% at >0.4 mg/l.
Selenium.....	±20% at >0.01 mg/l.

4. In § 141.24, paragraph (a) introductory text is revised, paragraph (e) is revised, paragraph (f) is removed and reserved; paragraph (g) introductory text is revised, paragraph (g)(4) and (g)(8)(i)(B) are revised, and a new paragraph (h) is added to read as follows:

**§ 141.24 Organic chemicals other than total trihalomethanes, sampling and analytical requirements.**

(a) Monitoring of endrin for purposes of determining compliance with the maximum contaminant level listed in § 141.12(a) shall be conducted as follows:

(1) \* \* \*

(e) Analysis made to determine compliance with the maximum contaminant level for endrin in § 141.12(a) shall be made in accordance with "Methods for Organochlorine Pesticides and Chlorophenoxy Acid Herbicides in Drinking Water and Raw Source Water," available from ORD Publications, CERL, EPA, Cincinnati, Ohio 45268; or "Organochlorine Pesticides in Water," Annual Book of ASTM Standards, part 31, Water, Method D-3088-79; or Method 509-A, pp. 555-565;<sup>1</sup> or Gas Chromatographic Methods for Analysis of Organic Substances in Water,<sup>2</sup> USGS, Book 5, Chapter A-3, pp. 24-39.

<sup>1</sup> "Standard Methods for the Examination of Water and Wastewater," 14th Edition, American Public Health Association, American Water Works Association, Water Pollution Control Federation, 1976.

<sup>2</sup> Techniques of Water-Resources Investigation of the United States Geological Survey, Chapter A-3 "Methods for Analysis of Organic Substances in Water," Book 5, 1972, Stock #2401-1227. Available from Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

(f) [Reserved]

(g) Monitoring of the contaminants listed in § 141.61(a) for purposes of determining compliance with the maximum contaminant levels shall be conducted as follows:

(1) \* \* \*

(4) The schedule for monitoring is as follows:

(i) To determine compliance with the MCLs for benzene, vinyl chloride, carbon tetrachloride, 1,2-dichloroethane, trichloroethylene, 1,1-dichloroethylene, 1,1,1-trichloroethane, and para-dichlorobenzene, each community water systems and non-transient non-community water system which serves more than 10,000 people shall analyze all distribution or entry-point samples, as appropriate, representing all source waters beginning no later than January 1, 1988. Each community water systems and non-transient non-community water systems serving from 3,300 to 10,000 people shall analyze all distribution or entry-point samples, as required in this paragraph (g), representing source waters beginning no later than January 1, 1989. All other community and non-transient non-community water systems shall analyze distribution or entry-point samples, as required in this paragraph (g), representing all source waters beginning no later than January 1, 1991.

(ii) For all other contaminants listed in § 141.61(a), (cis-1,2-dichloroethylene, 1,2-dichloropropane, ethylbenzene,



monochlorobenzene, o-dichlorobenzene, styrene, tetrachloroethylene, toluene, trans-1,2-dichloroethylene, and xylene(s)) each community water systems and non-transient, non-community water systems serving more than 10,000 people shall analyze and report results to the State, distribution or entry-point samples, as appropriate, representing all source waters to begin no later than *[six months after publication of this final rule in the Federal Register]*. All community water systems and non-transient, non-community water systems serving from 3,300 to 10,000 people shall analyze and report results to the State all distribution or entry-point samples, as required in this paragraph (g), representing source waters to begin no later than *[18 months after publication of this final rule in the Federal Register]*. All other community and non-transient, non-community water systems shall analyze and report results to the State, all distribution or entry-point samples, as required in this paragraph (g), representing all source waters to be completed no later than *[42 months after publication of this final rule in the Federal Register]*.

(8) \* \* \*

(i) \* \* \*

(A) \* \* \*

(B) When VOCs are not detected in the first year of quarterly sampling (or any subsequent sample that may be taken) and the system is vulnerable as defined in paragraph (g)(8)(iv) of this section,

(1) Monitoring (i.e., one sample) must be repeated every 3 years for systems > 500 connections.

(2) Monitoring (i.e., one sample) must be repeated every 5 years for systems > 500 connections.

(h) Analysis of the contaminants listed in § 141.61(c) shall be conducted during periods of highest susceptibility vulnerability (i.e., after rain, application of pesticides, etc.) as follows:

(1) The State shall determine by *[insert 18 months after publication of this final rule in the Federal Register]* whether a community or non-transient, non-community water system is vulnerable to one or more contaminants based upon an assessment. The assessment shall consider the following factors:

(i) Previous analytical results.

(ii) The proximity of the system to a potential point or non-point source of contamination. Point sources include spills and leaks of chemicals at or near a water treatment facility or at manufacturing, distribution, or storage

facilities, or from hazardous and municipal waste landfills and other waste handling or treatment facilities. Non-point sources include the use of pesticides to control insect and weed pests on agricultural areas, forest lands, home and gardens, and other land application uses.

(iii) The environmental persistence of the pesticide or PCBs.

(iv) How well the water source is protected against contamination due to such factors as depth of the well and the type of soil.

(v) Elevated nitrate levels at the water supply source.

(vi) Use of PCBs in equipment used in the production, storage, or distribution of water (i.e., PCBs used in pumps, transformers, etc.).

(2) A system shall remain vulnerable to a contaminant listed in § 141.61(c) for a minimum of three years after detection of one or more such contaminants. Upon meeting the three year minimum the State may reclassify the system's vulnerability as to the contaminant(s) based upon a revised assessment.

(3) Upon a finding by the State that a system is vulnerable to one or more contaminants listed in § 141.61(c) each community and non-transient, non-community water system so designated shall monitor for the contaminants for which it was found vulnerable every three months for one year and report the results to the State by *[insert 4 years after publication of final rule in the Federal Register]*. After the initial monitoring, systems shall monitor in accordance with paragraphs (h) (12) and (13) of this section.

(4) A system may request the State to reassess its vulnerability to one or more contaminants listed in § 141.61(c) provided the initial monitoring conducted under paragraph (h)(3) of this section does not detect contamination.

(5) Systems are required to monitor only for contaminants listed in § 141.61(c) to which the system is vulnerable. Systems which are not classified as vulnerable to any contaminants listed in § 141.61(c) are not required to monitor.

(6) Vulnerable ground water systems shall take a minimum of one sample at every entry point to the distribution system which is representative of each well after treatment (hereafter called a sampling point). Each sample must be taken at the same sampling point unless conditions make another sampling point more representative of each source or treatment plant.

(7) Vulnerable surface water systems shall take a minimum of one sample at points in the distribution system that are representative of each source or at each

entry point to the distribution system after treatment (hereafter called a sampling point). Each sample must be taken at the same sampling point unless conditions make another sampling point more representative of each source or treatment plant.

(8) If the system draws water from more than one source and the sources are combined before distribution, the system must sample at an entry point to the distribution system during periods of normal operating conditions (i.e., when water representative of all sources is being used).

(9) The State may require a confirmation sample for positive or negative results. If a confirmation sample is taken, the confirmation result is averaged with the first sampling result and the average is used for the compliance determination as specified by § 141.24(h)(14). States have discretion to delete results of obvious sampling errors from this calculation.

(10) The State may reduce the total number of samples a system must analyze by allowing the use of compositing. Composit samples from a maximum of five sampling points are allowed. Compositing of samples must be done in the laboratory and analyzed within 14 days of sample collection. If the concentration in the composite sample detects one or more contaminants listed in § 141.61(c), then a follow-up sample must be taken and analyzed within 14 days from each sampling point included in the composite. If duplicates of the original sample taken from each sampling point used in the composite are available, the system may use these instead of resampling. The duplicate must be analyzed and the results reported to the State within 14 days of collection.

(11) For the initial round of sampling each vulnerable community and non-transient, non-community water system shall take a minimum of one sample every three months for one year (i.e., four quarterly samples) at each sampling point and analyze for the contaminants listed in § 141.61(c) to which it is vulnerable.

(12) The repeat monitoring frequency for groundwater systems after the year of initial monitoring is as follows:

(i) When an organic contaminant(s) listed in § 141.61(c) and analyzed by the system is not detected during the initial year of quarterly monitoring or any repeat monitoring required by paragraph (h)(12)(i) of this section, then:

(A) Systems > 500 service connections must monitor at each sampling point for the contaminants to which they are vulnerable every 3 years.



(B) Systems <500 service connections must monitor at each sampling point for the contaminants to which they are vulnerable every 5 years.

(ii) When an organic contaminant listed in § 141.61(c) is detected in any sample taken during the first year of monitoring or any subsequent monitoring, then:

(A) Systems >500 service connections must subsequently monitor at each sampling point every 3 months for any contaminant listed in § 141.61(c) to which they are vulnerable. After a system conducts three years of quarterly sampling, the State may allow the system to reduce the monitoring frequency for a contaminant to an annual sample at each sampling point if the concentration of the contaminant in each sample analyzed in the previous 3 years is <50 percent of the MCL for that contaminant.

(B) Systems <500 service connections must monitor annually at each sampling point for 3 years for any contaminants listed in § 141.61(c) to which they are vulnerable. When an organic contaminant listed in § 141.61(c) is not detected during 3 consecutive years of sampling, then the State may reduce the monitoring frequency for that contaminant to every 3 years. States have the discretion to require systems to monitor more frequently at any time.

(13) The repeat monitoring frequency for surface water systems is as follows:

(i) When an organic contaminant listed in § 141.61(c) and analyzed by the system is not detected during the initial year of quarterly monitoring or any repeat monitoring required by paragraph (h)(13)(i) of this section, then:

(A) Systems >500 service connections must monitor quarterly at each sample point for the contaminants to which they are vulnerable for one year every three years.

(B) Systems <500 service connections must monitor quarterly at each sampling point for the contaminants to which they are vulnerable for one year every five years.

(ii) When an organic contaminant(s) listed in § 141.61(c) is detected in any sample taken during the first year of monitoring or any subsequent monitoring, then:

(A) Systems >500 service connections must subsequently monitor at each sampling point every three months for any contaminants listed in § 141.61(c) to which they are vulnerable. After a system conducts three years of quarterly sampling, the State may allow the system to reduce the monitoring frequency for a contaminant to an annual sample at each sampling point if the concentration of the contaminant in

each sample analyzed in the previous 3 years is <50 percent of the MCL for this contaminant.

(B) Systems <500 service connections must monitor annually at each sampling point for any contaminant listed in § 141.61(c) to which they are vulnerable. The State has the discretion to require systems to monitor more frequently (i.e., quarterly).

(14) Compliance with § 141.61(c) shall be determined based on the analytical results obtained at each sampling point.

(i) For ground water systems which are conducting quarterly monitoring, compliance is determined by a running annual average of all samples taken at each sampling point. If the annual average of any sampling point is greater than the MCL, then the system is out of compliance. If the initial sample or a subsequent sample would cause the annual average to be exceeded, then the system is out of compliance immediately.

(ii) For surface water systems which are conducting quarterly or more frequent monitoring, compliance is determined by a running annual average of all samples taken at each sampling point. If the annual average of any sampling point is greater than the MCL, then the system is out of compliance.

(iii) If monitoring is conducted annually, or less frequently, the system is out of compliance if the level of a contaminant at any sampling point is greater than the MCL. If a confirmation sample is required by the State, the determination of compliance will be based on the average of two samples.

(iv) If a public water system has a distribution system separable from other parts of the distribution system with no interconnections, only that part of the system that exceeds the MCL as specified in § 141.61(c) will be out of compliance. The State may allow the system to give public notice to only that portion of the system which is out of compliance.

(15) Analysis for the contaminants listed in § 141.61(c) shall be conducted using the following EPA methods or their equivalent as approved by EPA.

(i) Method 504, "1,2-Dibromoethane (EDB) and 1,2-Dibromo-3-chloropropane (DBCP) in Water by Microextraction and Gas Chromatography." Method 504 can be used to measure dibromo-chloropropane and ethylene dibromide.

(ii) Method 505, "Analysis of Organohalide Pesticides and Aroclors in Drinking Water by Microextraction and Gas Chromatography." Method 505 can be used to measure alachlor, atrazine, chlordane, heptachlor, heptachlor epoxide, lindane, methoxychlor, and

toxaphene. Method 505 can be used as a screen for PCBs.

(iii) Method 507, "Determination of Nitrogen- and Phosphorus-Containing Pesticides in Ground Water by Gas Chromatography with a Nitrogen-Phosphorus Detector." Method 507 can be used to measure alachlor and atrazine.

(iv) Method 508, "Determination of Chlorinated Pesticides in Ground Water by Gas Chromatography with an Electron Capture Detector." Method 508 can be used to measure chlordane, heptachlor, heptachlor epoxide, lindane and methoxychlor. Method 508 can be used as a screen for PCBs.

(v) Method 508A, "Total Polychlorinated Biphenyls (PCBs) by Perchlorination/Gas Chromatography." Method 508A is used to quantitate PCBs (as decachlorobiphenyl).

(vi) Method 515.1, "Determination of Chlorinated Acids in Ground Water by Gas Chromatography with an Electron Capture Detector." Method 515.1 can be used to measure 2,4-D, 2,4,5-TP (Silvex) and pentachlorophenol.

(vii) Method 531.1, "Measurement of N-Methyl Carbamoyloximes and N-Methyl Carbamates in Ground Water by Direct Aqueous Injection HPLC with Post-Column Derivatization." Method 531.1 can be used to measure aldicarb, aldicarb sulfoxide, aldicarb sulfone, and carbofuran.

(16) Analysis for PCBs shall be conducted as follows:

(i) Each system which monitors for PCBs shall analyze each sample using either Method 505 or Method 508 (see paragraph (15)).

(ii) If PCBs (as Aroclors or as any individual or group of isomers or congeners) are detected in any sample analyzed using Methods 505 or 508, the system shall reanalyze the sample using Method 508A to quantitate PCBs (as decachlorobiphenyl).

(iii) Compliance with the PCB MCL shall be determined based upon the quantitative results of analyses using Method 508A.

(17) If monitoring data collected after January 1, 1986, was generally consistent with the requirements of § 141.24(h), then the State may allow systems to use that data to satisfy the initial monitoring requirement of § 141.24(h)(3).

(18) The State may increase the required monitoring frequency, where necessary, to detect variations within the system (e.g., fluctuations in concentration due to seasonal use, changes in water source).

(19) The State has the authority to determine compliance or initiate



enforcement action based upon analytical results and other information compiled by their sanctioned representatives and agencies.

5. In § 141.32, paragraph (a)(1)(iii)(B) is revised, paragraphs (e) (10) through (14) are reserved, and paragraphs (e) (15) through (52) are added to read as follows:

**§ 141.32 General Public Notification Requirements.**

(a) \* \* \*

(1) \* \* \*

(iii) \* \* \*

(B) Violation of the MCL for nitrate/nitrite as defined in § 141.11 or § 141.62 (as appropriate) and determined according to § 141.23(h)(3).

\* \* \*

(e) \* \* \*

(10)–(14) Reserved

(15) *Asbestos*. The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined that asbestos fibers greater than 10  $\mu\text{m}$  are a health concern at certain levels of exposure. Asbestos is a naturally occurring mineral. Most asbestos fibers in drinking water are less than 10  $\mu\text{m}$  in length and occur in drinking water from natural sources. Asbestos was once a popular insulating and fire retardant material used for pipes and heating equipment and may get into drinking water as asbestos cement pipes corrode over time. Ingestion of asbestos is associated with cancer in rats. Chemicals that cause cancer in laboratory animals also may increase the risk of cancer in humans who are exposed over long periods of time. EPA has set the drinking water standard for asbestos at 7 million long fibers per liter to reduce the risk of cancer or other adverse health effects which have been observed in laboratory animals. Drinking water which meets the EPA standard is associated with little to none of this risk and should be considered safe with respect to asbestos.

(16) *Barium*. The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined that barium is a health concern at certain levels of exposure. This inorganic chemical occurs naturally in some types of minerals that may serve as sources of ground water. It is also used in oil and gas drilling muds, automotive paints, bricks, tiles and jet fuels. It generally gets into drinking water after dissolving from naturally occurring minerals in the ground. This chemical has been shown to damage the heart and cardiovascular system, and is associated with high blood pressure in laboratory animals such as rats exposed

to high levels during their lifetimes. EPA has set the drinking water standard for barium at 5 parts per million (ppm) to protect against the risk of these adverse health effects. Drinking water which meets the EPA standard is associated with little to none of this risk and should be considered safe with respect to barium.

(17) *Cadmium*. The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined that cadmium is a health concern at certain levels of exposure. Smoking of tobacco is a common source of general exposure. This inorganic metal is a contaminant in the metals used to galvanize pipe. It generally gets into water by corrosion of galvanized pipes or by improper waste disposal. This chemical has been shown to damage the kidney in animals such as rats and mice when the animals are exposed at high levels over their lifetimes. Some industrial workers who were exposed to relatively large amounts of this chemical during working careers also suffered damage to the kidney. EPA has set the drinking water standard for cadmium at 0.005 parts per million (ppm) to protect against the risk of these adverse health effects. Drinking water which meets the EPA standard is associated with little to none of this risk and should be considered safe with respect to cadmium.

(18) *Chromium*. The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined that chromium is a health concern at certain levels of exposure. This inorganic metal occurs naturally in the ground and is often used in the electroplating of metals. It generally gets into water from runoff from old mining operations and improper waste disposal from plating operations. This chemical has been shown to damage the kidney, nervous system, and the circulatory system of laboratory animals such as rats and mice when the animals are exposed at high levels over their lifetimes. Some humans who were exposed to this chemical suffered liver and kidney damage, dermatitis and respiratory problems. EPA has set the drinking water standard for chromium at 0.1 parts per million (ppm) to protect against the risk of these adverse health effects. Drinking water which meets the EPA standard is associated with little to none of this risk and should be considered safe with respect to chromium.

(19) *Mercury*. The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined that mercury is a health concern at certain levels of exposure.

This inorganic metal is used in electrical equipment and some water pumps. It usually gets into water as a result of improper waste disposal. This chemical has been shown to damage the kidney of laboratory animals such as rats when the animals are exposed at high levels over their lifetimes. EPA has set the drinking water standard for mercury at 0.002 parts per million (ppm) to protect against the risk of these adverse health effects. Drinking water which meets the EPA standard is associated with little to none of this risk and should be considered safe with respect to mercury.

(20) *Nitrate*. The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined that nitrate poses an acute health concern at certain levels of exposure. This inorganic chemical is used in fertilizer, and is associated with sewage and wastes from farm animals. It generally gets into water from sewage or as a result of agricultural fertilizing activity. Excessive levels of nitrate in drinking water has caused serious illness and sometimes death in young children under one year of age. Infants are at the greatest risk. The serious illness in children is caused because nitrate is converted to nitrite in the body and nitrite interferes with the oxygen carrying capacity of the child's blood. This is an acute disease in that the child can exhibit symptoms within hours of consuming water. Symptoms include shortness of breath and blueness of the skin. Clearly, expert medical advice should be sought immediately if these symptoms occur. However, they do not always occur. The purpose of this notice is to encourage parents and other responsible parties to provide children with an alternate source of drinking water. Local and State health authorities are the best source for information concerning alternate sources of drinking water for infants. You will receive notice as soon as a determination has been made that the drinking water is safe. EPA has set the drinking water standard at 10 parts per million (ppm) for nitrate to protect against the risk of these adverse effects. EPA has also set a drinking water standard for nitrite at 1 ppm. To allow for the fact that the toxicity of nitrate and nitrite are additive, EPA has also established a standard for effective nitrate (the sum of nitrate and nitrite) at 10 ppm. Drinking water which meets the EPA standard is associated with little to none of this risk and should be considered safe with respect to nitrate.

(21) *Nitrite*. The United States Environmental Protection Agency (EPA) sets drinking water standards and has



determined that nitrite poses an acute health concern at certain levels of exposure. This inorganic chemical is used in fertilizer, and is associated with sewage and wastes from farm animals. It generally gets into water from sewage or as a result of agricultural fertilizing activity. While excessive levels of nitrite in drinking water have not been observed, other sources of nitrite have caused serious illness and sometimes death in young children under one year of age. Infants are at the greatest risk. The serious illness in children is caused because nitrate is converted to nitrite in the body and nitrite interferes with the oxygen carrying capacity of the child's blood. This is an acute disease in that the child can exhibit symptoms within hours of consuming water. Symptoms include shortness of breath and blueness of the skin. Clearly, expert medical advice should be sought immediately if these symptoms occur. However, they do not always occur. The purpose of this notice is to encourage parents and other responsible parties to provide children with an alternate source of drinking water. Local and State health authorities are the best source for information concerning alternate sources of drinking water for infants. You will receive notice as soon as a determination has been made that the drinking water is safe. EPA has set the drinking water standard at 1 part per million (ppm) for nitrite to protect against the risk of these adverse effects. EPA has also set a drinking water standard for nitrate at 10 ppm and for effective nitrate (the sum of nitrate and nitrite) at 10 ppm. Drinking water which meets the EPA standard is associated with little to none of this risk and should be considered safe with respect to nitrite.

(22) *Selenium*. The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined that selenium is a health concern at certain high levels of exposure. Selenium is also an essential nutrient at low levels of exposure. This inorganic chemical is found naturally in soils and is used in electronics, photocopy operations, the manufacture of glass, chemicals, drugs, and as a fungicide and a feed additive. This chemical has been shown to damage the kidney, nervous system, and the circulatory system of laboratory animals such as rats and mice when the animals are exposed at high levels over their lifetimes. Some industrial workers who were exposed to relatively large amounts of this chemical during working careers also suffered damage to the liver, nervous system, and circulatory

system. EPA has set the drinking water standard for selenium at 0.05 parts per million (ppm) to protect against the risk of these adverse health effects. Drinking water which meets the EPA standard is associated with little to none of this risk and should be considered safe with respect to selenium.

(23) *Acrylamide*. The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined that acrylamide is a health concern at certain levels of exposure. Polymers made from this chemical are sometimes used to treat water supplies to remove particulate contaminants. This chemical has been shown to cause cancer in laboratory animals such as rats and mice when the animals are exposed at high levels over their lifetimes. Chemicals that cause cancer in laboratory animals also may increase the risk of cancer in humans who are exposed over long periods of time. EPA has set the drinking water standard for acrylamide using a treatment technique to reduce the risk of cancer or other adverse health effects which have been observed in laboratory animals. This treatment technique limits the amount of acrylamide which may be added to drinking water to remove particulate contaminant. Drinking water which uses this treatment technique is associated with little to none of this risk and should be considered safe with respect to acrylamide.

(24) *Alachlor*. The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined that alachlor is a health concern at certain levels of exposure. This organic chemical is a widely used pesticide. It generally gets in to drinking water after application to corn, soy beans or other crops. This chemical has been shown to cause cancer in laboratory animals such as rats and mice when the animals are exposed at high levels over their lifetimes. Chemicals that cause cancer in laboratory animals also may increase the risk of cancer in humans who are exposed over long periods of time. EPA has set the drinking water standard for alachlor at 0.002 parts per million (ppm) to reduce the risk of cancer or other adverse health effects which have been observed in laboratory animals. Drinking water which meets this standard is associated with little to none of this risk and should be considered safe with respect to alachlor.

(25) *Aldicarb*. The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined that aldicarb is a health concern at certain levels of exposure.

Aldicarb is a widely used pesticide and generally gets into drinking water after application to crops such as potatoes or peanuts. This chemical has been shown to damage the nervous system in laboratory animals such as rats exposed to high levels. EPA has set the drinking water standard for aldicarb at 0.01 parts per million (ppm) to protect against the risk of adverse health effects. EPA has also set a drinking water standard of 0.01 ppm for total aldicarb. Drinking water which meets the EPA standard is associated with little to none of this risk and should be considered safe with respect to aldicarb.

(26) *Aldicarb sulfoxide*. The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined that aldicarb sulfoxide is a health concern at certain levels of exposure. Aldicarb sulfoxide is a widely used pesticide and generally gets into drinking water after application to crops such as potatoes or peanuts. This chemical has been shown to damage the nervous system in laboratory animals such as rats exposed to high levels. EPA has set the drinking water standard for aldicarb sulfoxide at 0.01 parts per million (ppm) to protect against the risk of adverse health effects. EPA has also set a drinking water standard of 0.01 ppm for total aldicarb. Drinking water which meets the EPA standard is associated with little to none of this risk and should be considered safe with respect to aldicarb sulfoxide.

(27) *Aldicarb sulfone*. The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined that aldicarb sulfone is a health concern at certain levels of exposure. Aldicarb sulfone is a widely used pesticide and generally gets into drinking water after application to crops such as potatoes or peanuts. This chemical has been shown to damage the nervous system in laboratory animals such as rats exposed to high levels. EPA has set the drinking water standard for aldicarb sulfone at 0.04 parts per million (ppm) to protect against the risk of adverse health effects. EPA has also set a drinking water standard of 0.01 ppm for total aldicarb. Drinking water which meets the EPA standard is associated with little to none of this risk and should be considered safe with respect to aldicarb sulfone.

(28) *Atrazine*. The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined that atrazine is a health concern at certain levels of exposure. This organic chemical is a herbicide. It generally gets into drinking water by runoff into surface water or leaching



into ground water. This chemical has been shown to damage the liver and kidney of laboratory animals such as dogs and rats exposed at high levels over their lifetimes. EPA has set the drinking water standard for atrazine at 0.003 parts per million (ppm) to protect against the risk of these adverse health effects. Drinking water which meets the EPA standard is associated with little to none of this risk and should be considered safe with respect to atrazine.

(29) *Carbofuran*. The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined that carbofuran is a health concern at certain levels of exposure. This organic chemical is a pesticide. It generally gets into water by runoff into surface water or leaching into ground water. This chemical has been shown to damage the nervous and reproductive systems of laboratory animals such as rats and mice exposed at high levels over their lifetimes. Some humans who were exposed to relatively large amounts of this chemical during their working careers also suffered damage to the nervous system. EPA has set the drinking water standard for carbofuran at 0.04 parts per million (ppm) to protect against the risk of these adverse health effects. Drinking water which meets the EPA standard is associated with little to none of this risk and should be considered safe with respect to carbofuran.

(30) *Chlordane*. The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined that chlordane is a health concern at certain levels of exposure. This organic chemical is a pesticide used to control termites. It usually gets into drinking water after application near water supply intakes or wells. This chemical has been shown to cause cancer in laboratory animals such as rats and mice when the animals are exposed at high levels over their lifetimes. Chemicals that cause cancer in laboratory animals also may increase the risk of cancer in humans who are exposed over long periods of time. EPA has set the drinking water standard for chlordane at 0.002 parts per million (ppm) to reduce the risk of cancer or other adverse health effects which have been observed in laboratory animals. Drinking water that meets the EPA standard is associated with little to none of this risk and should be considered safe with respect to chlordane.

(31) *Dibromochloropropane (DBCP)*. The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined that DBCP is a health concern at certain

levels of exposure. This organic chemical was once a popular pesticide. It generally gets into drinking water after application to crops. This chemical has been shown to cause cancer in laboratory animals such as rats and mice when the animals are exposed at high levels over their lifetimes. Chemicals that cause cancer in laboratory animals also may increase the risk of cancer in humans who are exposed over long periods of time. EPA has set the drinking water standard for DBCP at 0.0002 parts per million (ppm) to reduce the risk of cancer or other adverse health effects which have been observed in laboratory animals. Drinking water which meets the EPA standard is associated with little to none of this risk and should be considered safe with respect to DBCP.

(32) *o-Dichlorobenzene*. The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined that o-dichlorobenzene is a health concern at certain levels of exposure. This organic chemical is used as a solvent in the production of pesticides and dyes. It generally gets into water by improper waste disposal. This chemical has been shown to damage the liver, kidney and the blood cells of laboratory animals such as rats and mice exposed to high levels during their lifetimes. Some industrial workers who were exposed to relatively large amounts of this chemical during working careers also suffered damage to the liver, nervous system, and circulatory system. EPA has set the drinking water standard for o-dichlorobenzene at 0.6 parts per million (ppm) to protect against the risk of these adverse health effects. Drinking water which meets the EPA standard is associated with little to none of this risk and should be considered safe with respect to o-dichlorobenzene.

(33) *cis-1,2-Dichloroethylene*. The United States Environmental Protection Agency (EPA) establishes drinking water standards and has determined that cis-1,2-dichloroethylene is a health concern at certain levels of exposure. This organic chemical is used as a solvent and intermediate in chemical production. It generally gets into water by improper waste disposal. This chemical has been shown to damage the liver, nervous system, and circulatory system of laboratory animals such as rats and mice when exposed at high levels over their lifetimes. Some humans who were exposed to relatively large amounts of this chemical also suffered damage to the nervous system. EPA has set the drinking water standard for cis-1,2-dichloroethylene at 0.07 parts per

million (ppm) to protect against the risk of these adverse health effects. Drinking water which meets the EPA standard is associated with little to none of this risk and should be considered safe with respect to cis-1,2-dichloroethylene.

(34) *trans-1,2-Dichloroethylene*. The United States Environmental Protection Agency (EPA) establishes drinking water standards and has determined that trans-1,2-dichloroethylene is a health concern at certain levels of exposure. This organic chemical is used as a solvent and intermediate in chemical production. It generally gets into water by improper waste disposal. This chemical has been shown to damage the liver, nervous system, and the circulatory system of laboratory animals such as rats and mice when exposed high levels over their lifetimes. Some humans who were exposed to relatively large amounts of this chemical also suffered damage to the nervous system. EPA has set the drinking water standard for trans-1,2-dichloroethylene at 0.1 parts per million (ppm) to protect against the risk of these adverse health effects. Drinking water which meets the EPA standard is associated with little to none of this risk and should be considered safe with respect to trans-1,2-dichloroethylene.

(35) *1,2-Dichloropropane*. The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined that 1,2-dichloropropane is a health concern at certain levels of exposure. This organic chemical is used as a solvent and pesticide. It generally gets into drinking water by runoff into surface water or leaching into ground water as a result of pesticide application and improper waste disposal. This chemical has been shown to cause cancer in laboratory animals such as rats and mice when the animals are exposed at high levels over their lifetimes. Chemicals that cause cancer in laboratory animals also may increase the risk of cancer in humans who are exposed over long periods of time. EPA has set the drinking water standard for 1,2-dichloropropane at 0.005 parts per million (ppm) to reduce the risk of cancer or other adverse health effects which have been observed in laboratory animals. Drinking water which meets the EPA standard is associated with little to none of this risk and should be considered safe with respect to 1,2-dichloropropane.

(36) *2,4-D*. The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined that 2,4-D is a health concern at certain levels of exposure. This organic chemical is used to control



algae in reservoirs. It generally leaches into groundwater or runs off into surface water after application as a weed killer. This chemical has been shown to produce adverse effects characterized by damage to the liver and kidney of laboratory animals such as rats exposed at high levels during their lifetimes. Some humans who were exposed to relatively large amounts of this chemical also suffered damage to the nervous system. EPA has set the drinking water standard for 2,4-D at 0.07 parts per million (ppm) to protect against the risk of these adverse health effects. Drinking water which meets the EPA standard is associated with little to none of this risk and should be considered safe with respect to 2,4-D.

(37) *Epichlorohydrin*. The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined that epichlorohydrin is a health concern at certain levels of exposure. Polymers made from this chemical are sometimes used in the treatment of water supplies as a flocculant to remove particulates. It generally gets into drinking water by improper use of water treatment chemicals. This chemical has been shown to cause cancer in laboratory animals such as rats and mice when the animals are exposed at high levels over their lifetimes. Chemicals that cause cancer in laboratory animals also may increase the risk of cancer in humans who are exposed over long periods of time. EPA has set the drinking water standard for epichlorohydrin using a treatment technique to reduce the risk of cancer or other adverse health effects which have been observed in laboratory animals. This treatment technique limits the amount of epichlorohydrin which may be added to drinking water as a flocculant to remove particulate. Drinking water which uses this treatment technique is associated with little to none of this risk and should be considered safe with respect to epichlorohydrin.

(38) *Ethylbenzene*. The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined ethylbenzene is a health concern at certain levels of exposure. This organic chemical is a major component of gasoline. It generally gets into water by improper waste disposal or leaking gasoline tanks. This chemical has been shown to damage the kidney, liver, and nervous system of laboratory animals such as rats exposed to high levels during their lifetimes. EPA has set the drinking water standard for ethylbenzene at 0.7 parts per million (ppm) to protect against the risk of these

adverse health effects. Drinking water which meets the EPA standard is associated with little to none of this risk and should be considered safe with respect to ethylbenzene.

(39) *Ethylene Dibromide (EDB)*. The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined that EDB is a health concern at certain levels of exposure. This organic chemical was once a popular pesticide. It generally gets into drinking water after application to crops by leaching into ground water. This chemical has been shown to cause cancer in laboratory animals such as rats and mice when the animals are exposed at high levels over their lifetimes. Chemicals that cause cancer in laboratory animals also may increase the risk of cancer in humans who are exposed over long periods of time. EPA has set the drinking water standard for EDB at 0.00005 parts per million (ppm) to reduce the risk of cancer or other adverse health effects which have been observed in laboratory animals. Drinking water which meets this standard is associated with little to none of this risk and should be considered safe with respect to EDB.

(40) *Heptachlor*. The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined that heptachlor is a health concern at certain levels of exposure. This organic chemical was once a popular pesticide. It generally gets into drinking water by runoff into surface water or leaching into ground water. This chemical has been shown to cause cancer in laboratory animals such as rats and mice when the animals are exposed at high levels over their lifetimes. Chemicals that cause cancer in laboratory animals also may increase the risk of cancer in humans who are exposed over long periods of time. EPA has set the drinking water standards for heptachlor at 0.0004 parts per million (ppm) to reduce the risk of cancer or other adverse health effects which have been observed in laboratory animals. Drinking water which meets this standard is associated with little to none of this risk and should be considered safe with respect to heptachlor.

(41) *Heptachlor Epoxide*. The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined that heptachlor epoxide is a health concern at certain levels of exposure. This organic chemical was once a popular pesticide. It generally gets into drinking water by runoff into surface water or leaching into ground water. This chemical has been shown to cause cancer in laboratory animals such

as rats and mice when the animals are exposed at high levels over their lifetimes. Chemicals that cause cancer in laboratory animals also may increase the risk of cancer in humans who are exposed over long periods of time. EPA has set the drinking water standards for heptachlor epoxide at 0.0002 parts per million (ppm) to reduce the risk of cancer or other adverse health effects which have been observed in laboratory animals. Drinking water which meets this standard is associated with little to none of this risk and should be considered safe with respect to heptachlor epoxide.

(42) *Lindane*. The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined that lindane is a health concern at certain levels of exposure. This organic chemical is used as a pesticide. It generally gets into drinking water by runoff into surface water or leaching into ground water after application to crops. This chemical has been shown to damage the liver, kidney, nervous system, and immune system of laboratory animals such as rats, mice and dogs exposed at high levels during their lifetimes. Some humans who were exposed to relatively large amounts of this chemical also suffered damage to the nervous system and circulatory system. EPA has established the drinking water standard for lindane at 0.0002 parts per million (ppm) to protect against the risk of these adverse health effects. Drinking water which meets the EPA standard is associated with little to none of this risk and should be considered safe with respect to lindane.

(43) *Methoxychlor*. The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined that methoxychlor is a health concern at certain levels of exposure. This organic chemical is used as a pesticide. It generally gets into water by runoff into surface water or leaching into ground water. This chemical has been shown to damage the liver, kidney, nervous system, and circulatory system of laboratory animals such as rats exposed at high levels during their lifetimes. It has also been shown to produce growth retardation in rats. EPA has set the drinking water standard for methoxychlor at 0.4 parts per million (ppm) to protect against the risk of these adverse health effects. Drinking water which meets the EPA standard is associated with little to none of this risk and should be considered safe with respect to methoxychlor.

(44) *Monochlorobenzene*. The United States Environmental Protection Agency (EPA) sets drinking water standards and



has determined that monochlorobenzene is a health concern at certain levels of exposure. This organic chemical is used as a solvent. It generally gets into water by improper waste disposal. This chemical has been shown to damage the liver, kidney and nervous system of laboratory animals such as rats and mice exposed to high levels during their lifetimes. EPA has set the drinking water standard for monochlorobenzene at 0.1 parts per million (ppm) to protect against the risk of these adverse health effects. Drinking water which meets the EPA standard is associated with little to none of this risk and should be considered safe with respect to monochlorobenzene.

(45) *Polychlorinated biphenyls (PCBs)*. The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined that polychlorinated biphenyls (PCBs) are a health concern at certain levels of exposure. These organic chemicals were once widely used in electrical transformers and other industrial equipment. They generally get into drinking water by improper waste disposal or leaking electrical industrial equipment. This chemical has been shown to cause cancer in laboratory animals such as rats and mice when the animals are exposed at high levels over their lifetimes. Chemicals that cause cancer in laboratory animals also may increase the risk of cancer in humans who are exposed over long periods of time. EPA has set the drinking water standard for PCBs at 0.0005 parts per million (ppm) to reduce the risk of cancer or other adverse health effects which have been observed in laboratory animals. Drinking water which meets this standard is associated with little to none of this risk and should be considered safe with respect to PCBs.

(46) *Pentachlorophenol*. The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined that pentachlorophenol is a health concern at certain levels of exposure. This organic chemical is used as a wood preservative, herbicide, disinfectant, and defoliant. It generally gets into drinking water by runoff into surface water or leaching into ground water. This chemical has been shown to produce adverse reproductive effects and to damage the liver and kidneys of laboratory animals such as rats exposed to high levels during their lifetimes. Some humans who were exposed to relatively large amounts of this chemical also suffered damage to the liver and kidneys. EPA has set the drinking water standard for pentachlorophenol at 0.2 parts per million (ppm) to protect

against the risk of these adverse health effects. Drinking water which meets the EPA standard is associated with little to none of this risk and should be considered safe with respect to pentachlorophenol.

(47) *Styrene*. The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined that styrene is a health concern at certain levels of exposure. This organic chemical is commonly used to make plastics and is sometimes a component of resins used for drinking water treatment and by improper waste disposal. This chemical has been shown to cause cancer in laboratory rats and mice when the animals are exposed to high levels over their lifetimes. Chemicals that cause cancer in laboratory animals also may increase the risk of cancer in humans who are exposed over a long period of time. EPA has set the drinking water standard for styrene at 0.005/1 parts per million (ppm) to reduce the risk of cancer and other adverse health effects. Drinking water which meets the EPA standard is associated with little to none of this risk and should be considered safe with respect to styrene.

(48) *Tetrachloroethylene*. The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined that tetrachloroethylene is a health concern at certain levels of exposure. This organic chemical has been a popular general and dry cleaning solvent. It generally gets into drinking water by improper waste disposal. This chemical has been shown to cause cancer in laboratory animals such as rats and mice when the animals are exposed at high levels over their lifetimes. Chemicals that cause cancer in laboratory animals also may increase the risk of cancer in humans who are exposed over long periods of time. EPA has set the drinking water standard for tetrachloroethylene at 0.005 parts per million (ppm) to reduce the risk of cancer or other adverse health effects which have been observed in laboratory animals. Drinking water which meets this standard is associated with little to none of this risk and should be considered safe with respect to tetrachloroethylene.

(49) *Toluene*. The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined that toluene is a health concern at certain levels of exposure. This organic chemical is used as a solvent and in the manufacture of gasoline for airplanes. It generally gets into water by improper waste disposal or leaking underground storage tanks.

This chemical has been shown to damage the kidney, nervous system, and circulatory system of laboratory animals such as rats and mice exposed to high levels during their lifetimes. Some industrial workers who were exposed to relatively large amounts of this chemical during working careers also suffered damage to the liver, kidney and nervous system. EPA has set the drinking water standard for toluene at 2 parts per million (ppm) to protect against the risk of these adverse health effects. Drinking water which meets the EPA standard is associated with little to none of this risk and should be considered safe with respect to toluene.

(50) *Toxaphene*. The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined that toxaphene is a health concern at certain levels of exposure. This organic chemical was once a pesticide widely used on cotton, corn, soybeans, pineapples and other crops. It generally gets into drinking water by runoff into surface water or leaching into ground water. This chemical has been shown to cause cancer in laboratory animals such as rats and mice when the animals are exposed at high levels over their lifetimes. Chemicals that cause cancer in laboratory animals also may increase the risk of cancer in humans who are exposed over long periods of time. EPA has set the drinking water standard for toxaphene at 0.005 parts per million (ppm) to reduce the risk of cancer or other adverse health effects which have been observed in laboratory animals. Drinking water which meets this standard is associated with little to none of this risk and should be considered safe with respect to toxaphene.

(51) *2,4,5-TP*. The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined that 2,4,5-TP is a health concern at certain levels of exposure. This organic chemical is used as a herbicide. It generally gets into water by runoff into surface water or leaching into ground water. This chemical has been shown to damage the liver and kidney of laboratory animals such as rats and dogs exposed to high levels during their lifetimes. Some industrial workers who were exposed to relatively large amounts of this chemical during working careers also suffered damage to the nervous system. EPA has set the drinking water standard for 2,4,5-TP at 0.05 parts per million (ppm) to protect against the risk of these adverse health effects. Drinking water which meets the EPA standard is associated with little to



none of this risk and should be considered safe with respect to 2,4,5-TP.

(52) *Xylene*. The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined that xylene is a health concern at certain levels of exposure. This organic chemical is used in the manufacture of gasoline for airplanes and as a solvent for pesticides, and as a cleaner and degreaser of metals. It usually gets into water by improper waste disposal. This chemical has been shown to damage the liver, kidney and nervous system of laboratory animals such as rats and dogs exposed to high levels during their lifetimes. Some humans who were exposed to relatively large amounts of this chemical also suffered damage to the nervous system. EPA has set the drinking water standard for xylene at 10 parts per million (ppm) to protect against the risk of these adverse health effects. Drinking water which meets the EPA standard is associated with little to none of this risk and should be considered safe with respect to xylene.

6. In § 141.40 the section heading is revised and new paragraphs (n) through (p) are added to read as follows:

**§ 141.40 Special monitoring for inorganic and organic chemicals.**

(n) Monitoring of the organic contaminants listed in § 141.40(n)(10) shall be conducted during periods of highest vulnerability as follows:

(1) The State shall determine whether a community or non-transient, non-community water system is vulnerable to one or more contaminants based upon an assessment. The assessment shall consider the criteria specified in § 141.24(h)(1).

(2) Upon a finding by the State that the system is vulnerable to a contaminant listed in § 141.40(n)(10), each community and non-transient, non-community water system so designated shall monitor for the contaminant every 3 months for one year and report the results to the State by *[insert 4 years after publication of the final rule in the Federal Register]*.

(3) Systems which are not designated by the State as vulnerable to a contaminant listed in § 141.40(n)(10) are not required to monitor for that contaminant.

(4) Vulnerable ground water systems shall take a minimum of one sample at every entry point to the distribution system which is representative of each well after treatment (hereafter called a sampling point). Each sample must be taken at the same sampling point unless conditions make another sampling point

more representative of each source or treatment plant.

(5) Vulnerable surface water systems shall take a minimum of one sample at points in the distribution system that are representative of each source or at each entry point to the distribution system after treatment (hereafter called a sampling point). Each sample must be taken at the same sampling point unless conditions make another sampling point more representative of each source or treatment plant.

(6) If the system draws water from more than one source and the sources are combined before distribution, the system must sample at an entry point to the distribution system during periods of normal operating conditions (i.e., when water representative of all sources is being used).

(7) The State may require a confirmation sample for positive or negative results.

(8) The State may reduce the total number of samples a system must analyze by allowing the use of compositing. Composite samples from a maximum of five sampling points are allowed. Compositing of samples must be done in the laboratory and the composite sample must be analyzed within 14 days of collection.

(9) Instead of performing the monitoring required by this section, a community water system or non-transient non-community water system serving fewer than 150 service connections may send a letter to the State stating that the system is available for sampling. This letter must be sent to the State no later than 3 years after promulgation of final rule. The system shall not send such samples to State, unless requested to do so by the State.

(10) List of Unregulated Organic Contaminants:

Contaminant	EPA analytical method
(i) Metribuzin.....	507, 508
(ii) Hexachlorobenzene.....	505, 508
(iii) Dalapon.....	515.1
(iv) Dinoseb.....	515.1
(v) Picloram.....	515.1
(vi) Oxamyl (vydate).....	531.1
(vii) Simazine.....	505, 507
(viii) Glyphosate.....	547
(ix) Hexachlorocyclopentadiene.....	505, 525
(x) PAHs.....	525, 550, 550.1
(xi) Phthalates.....	506, 525
(xii) 2,3,7,8-TCDD (Dioxin).....	513
(xiii) Aldrin.....	505, 508
(xiv) Dieldrin.....	505, 508
(xv) 2,4-DB.....	515.1
(xvi) Dicamba.....	515.1
(xvii) 2,4,5-T.....	515.1
(xviii) Carbaryl.....	531.1
(xix) 3-Hydroxycarbofuran.....	531.1
(xx) Methomyl.....	531.1
(xxi) Butachlor.....	505, 507

Contaminant	EPA analytical method
(xxii) Metolachlor.....	505, 507
(xxiii) Propachlor.....	505, 507

(o) Monitoring of the inorganic contaminants listed in § 141.40(o)(9) shall be conducted as follows:

(1) The State shall determine whether a community or non-transient, non-community water system is vulnerable to one or more contaminants based upon an assessment. The assessment shall consider the potential contamination of the water source by a contaminant(s) listed in § 141.40(o)(9).

(2) Upon a finding by the State that the system is vulnerable to a contaminant(s) listed in § 141.40(o)(9), each community and non-transient, non-community water system so designated shall monitor as specified below for the contaminant(s) and report the results to the State by *[insert 4 years after publication of the final rule in the Federal Register]*.

(3) Systems which are not designated by the State as vulnerable to a contaminant listed in § 141.40(o)(9) are not required to monitor.

(4) Vulnerable groundwater systems shall take a minimum of one sample at every entry point to the distribution system which is representative of each well after treatment (hereafter called a sampling point).

(5) Vulnerable surface water systems shall take a minimum of one sample at every entry point to the distribution system or in the distribution system at a point which is representative of each source after treatment (hereafter called a sampling point).

(6) If a system draws water from more than one source and the sources are combined before distribution, the system must sample at an entry point to the distribution system during periods of normal operating conditions (i.e., when water is representative of all sources being used).

(7) The State may reduce the total number of samples which must be analyzed by the system by allowing the use of compositing. Compositing of samples must be done in the laboratory. Composite samples from a maximum of five sampling points are allowed.

(8) Instead of performing the monitoring required by this section, a community water system or non-transient non-community water system serving fewer than 150 service connections may send a letter to the State stating that the system is available for sampling. This letter must be sent to the State no later than 3 years after



promulgation of final rule. The system shall not sent such samples to State, unless requested to do so by the State.

(9) List of Unregulated Inorganic Contaminants:

Contaminant	EPA analytical method
(i) Antimony.....	Graphite Furnace Atomic Absorption; Inductively Coupled Plasma.
(ii) Beryllium.....	Graphite Furnace Atomic Absorption; Inductively Coupled Mass Spectrometry Plasma; Spectrophotometric.
(iii) Nickel.....	Atomic Absorption; Inductively Coupled Plasma; Graphite Furnace Atomic Absorption.
(iv) Sulfate.....	Colorimetric.
(v) Thallium.....	Graphite Furnace Atomic Absorption; Inductively Coupled Mass Spectrometry Plasma.
(vi) Cyanide.....	Spectrophotometric.

(p) The State has the discretion to require monitoring for the contaminants listed below. Each system required by the State to monitor shall use the procedures specified in § 141.40(n) paragraphs (4), (5), (6), (7), (8), and (9).

Contaminant	EPA analytical method
(1) Ametryn.....	507
(2) Aspon.....	507
(3) Atraton.....	507
(4) Azinphos methyl.....	507
(5) Bolstar.....	507
(6) Bromacil.....	507
(7) Butylate.....	507
(8) Carboxin.....	507
(9) Chloroprotham.....	507
(10) Coumophos.....	507
(11) Cycloate.....	507
(12) Demeton-O.....	507
(13) Demeton-S.....	507
(14) Diazinon.....	507
(15) Dichlofenthion.....	507
(16) Dichlorvos.....	507
(17) Diphenamid.....	507
(18) Disulfoton.....	507
(19) Disulfoton sulfone.....	507
(20) Disulfoton sulfoxide.....	507
(21) EPN.....	507
(22) EPTC.....	507
(23) Ethion.....	507
(24) Ethoprop.....	507
(25) Ethyl parathion.....	507
(26) Famphur.....	507
(27) Fenamiphos.....	507
(28) Fenarimol.....	507
(29) Fenitrothion.....	507
(30) Fensulfotthion.....	507
(31) Fenthion.....	507
(32) Fluridone.....	507
(33) Fonofos.....	507
(34) Hexazinone.....	507
(35) Malathion.....	507
(36) Merphos.....	507
(37) Methyl paraoxon.....	507
(38) Methyl parathion.....	507
(39) Mevinphos.....	507
(40) MGK 264.....	507
(41) MGK 326.....	507
(42) Molinate.....	507
(43) Napropamide.....	507
(44) Nortriflurazone.....	507

Contaminant	EPA analytical method
(45) Pebulate.....	507
(46) Phorate.....	507
(47) Phosmet.....	507
(48) Prometon.....	507
(49) Prometryn.....	507
(50) Pronamide.....	507
(51) Propazine.....	507
(52) Simetryn.....	507
(53) Stirofos.....	507
(54) Tebuthiuron.....	507
(55) Terbacil.....	507
(56) Terbufos.....	507
(57) Terbutryn.....	507
(58) Triademafon.....	507
(59) Tricyclazole.....	507
(60) Vernolate.....	507
(61) Chlorneb.....	508
(62) Chlorobenzilate.....	508
(63) Chloropropylate.....	508
(64) Chlorothalonil.....	508
(65) Chlorpyrifos.....	507, 508
(66) DCPA.....	508
(67) 4,4'-DDD.....	508
(68) 4,4'-DDE.....	508
(69) 4,4'-DDT.....	508
(70) Dichloran.....	508
(71) Endosulfan I.....	508
(72) Endosulfan II.....	508
(73) Endosulfan sulfate.....	508
(74) Endrin aldehyde.....	508
(75) Etridiazole.....	508
(76) BCH-alpha.....	505, 508
(77) BCH-beta.....	505, 508
(78) BCH-delta.....	505, 508
(79) BCH-gamma.....	505, 508
(80) cis-Permethrin.....	508
(81) trans-Permethrin.....	508
(82) Trifluralin.....	507, 508
(83) Diquat.....	549
(84) Endothall.....	548

7. Section 141.50 is amended by adding paragraphs (a)(6) through (a)(18) and entries (4) through (21) in the table in paragraph (l) as follows:

§ 141.50 Maximum contaminant level goals for organic chemicals.

(a) * * *
(6) Acrylamide.
(7) Alachlor.
(8) Chlordane.
(9) Dibromochloropropane.
(10) 1,2-Dichloropropane.
(11) Epichlorohydrin.
(12) Ethylene dibromide.
(13) Heptachlor.
(14) Heptachlor epoxide.
(15) Polychlorinated biphenyls (PCBs).
(16) Styrene.
(17) Tetrachloroethylene.
(18) Toxaphene.
(b) * * *

Contaminant	MCLG (mg/l)
(4) Aldicarb.....	0.01
(5) Aldicarb sulfide.....	0.01
(6) Aldicarb sulfone.....	0.04
(7) Atrazine.....	0.003
(8) Carbofuran.....	0.04

Contaminant	MCLG (mg/l)
(9) o-Dichlorobenzene.....	0.6
(10) cis-1,2-Dichloroethylene.....	0.07
(11) trans-1,2-Dichloroethylene.....	0.1
(12) 2,4-D.....	0.07
(13) Ethylbenzene.....	0.7
(14) Lindane.....	0.0002
(15) Methoxychlor.....	0.4
(16) Monochlorobenzene.....	0.1
(17) Pentachlorophenol.....	0.2
(18) Styrene.....	0.1
(19) Toluene.....	2
(20) 2,4,5-TP.....	0.05
(21) Xylenes (total).....	10

8. Section 141.51 is amended by adding entries (2) through (9) in the table in paragraph (b) to read as follows:

§ 141.51 Maximum contaminant level goals for inorganic contaminants.

(b) \* \* \*

Contaminant	MCLG (mg/l)
(2) Asbestos.....	7 Million fibers/liter (longer than 10 µm).
(3) Barium.....	5.
(4) Cadmium.....	0.005.
(5) Chromium.....	0.1.
(6) Mercury.....	0.002.
(7) Nitrate*.....	10 (as Nitrogen).
(8) Nitrite*.....	1 (as Nitrogen).
(9) Selenium.....	0.05.

\* MCLG for total nitrate and nitrite = 10 mg/l.

9. Section 141.60, is revised to read as follows:

§ 141.60 Effective dates.

(a) The effective dates for § 141.61 are as follows:

(1) The effective date for paragraphs (a)(1) through (a)(8) of § 141.61 is January 9, 1989.

(2) The effective date for paragraphs (a)(9) through (a)(18) and (c)(1) through (c)(18) of § 141.61 is [insert 18 months after publication of final rule in the Federal Register].

(b) The effective dates for § 141.62 are as follows:

(1) The effective date of paragraph (b)(1) of § 141.62 is October 2, 1987.

(2) The Effective date for paragraphs (b)(2) through (b)(9) of § 141.62 is [insert 18 months after publication of final rule in the Federal Register].

10. Section 141.61, is revised to read as follows:

§ 141.61 Maximum Contaminant levels for organic contaminants.

(a) The following maximum contaminant levels for organic contaminants apply to community and non-transient, non-community water systems.



CAS No.	Contaminant	MCL (mg/l)
(1) 71-43-2	Benzene	0.005
(2) 56-23-5	Carbon tetrachloride	0.005
(3) 107-06-2	1,2-Dichloroethane	0.005
(4) 79-01-6	Trichloroethylene	0.005
(5) 106-46-7	para-Dichlorobenzene	0.075
(6) 75-35-4	1,1-Dichloroethylene	0.007
(7) 71-55-6	1,1,1-Trichloroethane	0.2
(8) 75-01-4	Vinyl chloride	0.002
(9) 156-59-2	cis-1,2-Dichloroethylene	0.07
(10) 78-87-5	1,2-Dichloropropane	0.005

CAS No.	Contaminant	MCL (mg/l)
(11) 100-41-4	Ethylbenzene	0.7
(12) 108-90-7	Monochlorobenzene	0.1
(13) 95-50-1	o-Dichlorobenzene	0.6
(14) 100-42-5	Styrene	0.005/0.1
(15) 127-18-4	Tetrachloroethylene	0.005
(16) 108-88-3	Toluene	2
(17) 156-60-5	trans-1,2-Dichloroethylene	0.1
(18) 1330-20-7	Xylenes (total)	10

(b) The Administrator, pursuant to section 1412 of the Act, hereby identifies as indicated in the Table below either granular activated carbon (GAC), packed tower aeration (PTA), or both as the best technology, treatment technique, or other means available for achieving compliance with the maximum contaminant level for synthetic organic contaminants identified in paragraphs (a) and (c) of this section:

#### BAT FOR SYNTHETIC ORGANIC CONTAMINANTS LISTED IN SECTION 141.61 (a) AND (c)

CAS No.	Chemical	GAC	PTA
15972-60-8	Alachlor	X	
116-06-3	Aldicarb	X	
1646-88-4	Aldicarb sulfone	X	
1646-87-3	Aldicarb sulfoxide	X	
1912-24-9	Atrazine	X	
71-43-2	Benzene	X	X
1563-86-2	Carbofuran	X	
56-23-5	Carbon tetrachloride	X	X
57-74-9	Chlordane	X	
94-75-7	2,4-D	X	
96-12-8	Dibromochloropropane (DBCP)	X	X
95-50-1	o-Dichlorobenzene	X	X
107-06-2	1,2-Dichloroethane	X	X
156-59-2	cis-1,2-Dichloroethylene	X	X
156-60-5	trans-1,2-Dichloroethylene	X	X
75-35-4	1,1-Dichloroethylene	X	X
78-87-5	1,2-Dichloropropane	X	X
106-93-4	Ethylene Dibromide (EDB)	X	X
100-41-4	Ethylbenzene	X	X
76-44-8	Heptachlor	X	
1024-57-3	Heptachlor epoxide	X	
58-89-9	Lindane	X	
72-43-5	Methoxychlor	X	
108-90-7	Monochlorobenzene	X	X
106-46-7	para-Dichlorobenzene	X	X
1336-36-3	Polychlorinated biphenyls (PCBs)	X	
87-86-5	Pentachlorophenol	X	
100-42-5	Styrene	X	X
93-72-1	2,4,5-TP (Silvex)	X	
127-18-4	Tetrachloroethylene	X	X
71-55-6	1,1,1-Trichloroethane	X	X
79-01-6	Trichloroethylene	X	X
108-88-3	Toluene	X	
8001-35-2	Toxaphene	X	X
75-01-4	Vinyl chloride	X	X
1330-20-7	Xylene	X	X

(c) The following Maximum Contaminant Levels for synthetic organic contaminants apply to community water systems and non-transient, non-community water systems.

CAS No.	Contaminant	MCL (mg/l)
(1) 15972-60-8	Alachlor	0.002
(2) 116-06-3	Aldicarb	0.01
(3) 1646-87-3	Aldicarb sulfoxide	0.01
(4) 1646-88-4	Aldicarb sulfone	0.04
(5) 1912-24-9	Atrazine	0.003
(6) 1563-86-2	Carbofuran	0.04
(7) 57-74-9	Chlordane	0.002
(8) 96-12-8	Dibromochloropropane	0.0002
(9) 94-75-7	2,4-D	0.07

CAS No.	Contaminant	MCL (mg/l)
(10) 106-93-4	Ethylene dibromide	0.00005
(11) 76-44-8	Heptachlor	0.0004
(12) 1024-57-3	Heptachlor epoxide	0.0002
(13) 58-89-9	Lindane	0.0002
(14) 72-43-5	Methoxychlor	0.4
(15) 1336-36-3	Polychlorinated biphenyls (PCBs) (as decachlorobiphenyl)	0.0005
(16) 87-86-5	Pentachlorophenol	0.2
(17) 8001-35-2	Toxaphene	0.005
(18) 93-72-1	2,4,5-TP	0.05

11. In Section 141.62 paragraph (b) is revised and a new paragraph (c) is added to read as follows:

#### § 141.62 Maximum contaminant levels for inorganic contaminants.

(a) [Reserved]

(b) The Maximum Contaminant Levels for inorganic contaminants specified in paragraphs (b) (2) through (6) and (b)(9) of this section apply to community water systems and non-transient, non-community water systems. This Maximum Contaminant Level specified in paragraph (b)(1) of this section only applies to community water systems. The Maximum Contaminant Levels specified in paragraphs (b)(7) and (b)(8) of this section apply to community; non-transient, non-community; and transient non-community water systems.



Contaminant	MCL (mg/l)
(1) Fluoride.....	4
(2) Asbestos.....	7 Million Fibers/liter (longer than 10 μm)
(3) Barium.....	5
(4) Cadmium.....	0.005
(5) Chromium.....	0.1
(6) Mercury.....	0.002
(7) Nitrate*	10 (as Nitrogen)
(8) Nitrite*	1 (as Nitrogen)
(9) Selenium.....	0.05

\* MCL for total nitrate and nitrite = 10 mg/l

(c) The Administrator, pursuant to section 1412 of the Act, hereby identifies the following as the best technology, treatment technique, or other means available for achieving compliance with the maximum contaminant level for inorganic contaminants identified in paragraph (b) of this section, except fluoride:

#### BAT FOR INORGANIC CONTAMINANTS LISTED IN § 141.62(b)

Chemical name	BAT(s)
Asbestos.....	2, 3, and 8.
Barium.....	5, 6, and 7.
Cadmium.....	2, 5, 6, and 7.
Chromium.....	2, 5, 6 <sup>2</sup> , and 7.
Mercury.....	2 <sup>1</sup> , 4, 6 <sup>1</sup> , and 7. <sup>1</sup>
Nitrate.....	5, and 7.
Nitrite.....	5, and 7.
Selenium.....	1, 2 <sup>3</sup> , 6, and 7.

<sup>1</sup> BAT only if influent Hg concentrations <10 μg/l.

<sup>2</sup> BAT for Chromium III only.

<sup>3</sup> BAT for Selenium IV only.

#### Key to BATs in Table

- 1=Activated Alumina
- 2=Coagulation/Filtration
- 3=Direct and Diatomite Filtration
- 4=Granular Activated Carbon
- 5=Ion Exchange
- 6=Lime Softening
- 7=Reverse Osmosis
- 8=Corrosion Control

12. A new Subpart K is added to Part 141 to read as follows:

#### Subpart K—Treatment Techniques

Sec.

141.110 General requirements.

141.111 Treatment techniques for acrylamide and epichlorohydrin.

#### Subpart K—Treatment Techniques

##### § 141.110 General requirements.

The requirements of Subpart K constitute national primary drinking water regulations. These regulations establish treatment techniques in lieu of maximum contaminant levels for specified contaminants.

##### § 141.111 Treatment techniques for acrylamide and epichlorohydrin.

Each public water system must certify annually in writing to the State that when acrylamide and epichlorohydrin are used in drinking water systems, the combination of dose and monomer level does not exceed the levels specified as follows:

Acrylamide = 0.05% dosed at 1 ppm  
Epichlorohydrin = 0.01% dosed at 20 ppm

#### PART 142—NATIONAL PRIMARY DRINKING WATER REGULATIONS IMPLEMENTATION

1. The authority citation for Part 142 continues to read as follows:

Authority: 42 U.S.C. 300g-2, 300g-3, 300g-4, 300g-5, 300j-4 and 300j-9.

2. In § 142.14, paragraph (d) is amended by reserving paragraphs (d)(4) through (d)(10) and by adding new paragraphs (d)(11) through (d)(16) as follows:

##### § 142.14 Records kept by States.

\* \* \*

(d) \* \* \*

(4)–(10) [Reserved]

(11) Records of any determination of a system's vulnerability to contamination made pursuant to §§ 141.23(b), 141.24(g) and (h), and 141.40(n) and (o). The records shall also include the basis for such determination.

(12) Records of any determination, made pursuant to §§ 141.23(c), 141.23(e), and/or 141.24(g) and (h) that a system may decrease the frequency of its monitoring and records of any determination, made pursuant to §§ 141.23(g), 141.24(g)(13) and 141.24(h)(18) requiring a system to increase monitoring frequency. The records shall include the basis for the decision and the new required monitoring frequency.

(13) Records of any determination made pursuant to § 141.23(d)(2) that a system is required to conduct repeat monitoring for asbestos, the basis for that decision, and the repeat monitoring frequency.

(14) Records of any decisions that systems must monitor for the unregulated contaminants listed in § 141.40(n) and (o).

(15) Records of any letters received from systems serving less than 150 service connections stating that the system is available for sampling for the contaminants listed in § 141.40(n) and (o).

(16) Records of annual certifications received from systems pursuant to Part 141 Subpart K demonstrating the system's compliance with the treatment techniques for acrylamide and/or epichlorohydrin in § 141.111.

3. In § 142.15, paragraph (a) is amended by reserving paragraphs (a)(1) through (a)(11) and by adding new paragraphs (a)(12) through (a)(17) as follows:

##### § 142.15 Reports by States.

(a) \* \* \*

(1)–(11) [Reserved]

(12) A list, including the PWS identification number, of all systems, on which, the State has conducted a vulnerability assessment pursuant to §§ 141.23(b), 141.24(g) and (h), 141.40(n) or 141.40(o). The report shall include the State's classification of the system as either vulnerable or not vulnerable to each contaminant and the basis for that determination.

(13) A list, including the PWS identification number of all systems which, the State has determined pursuant to §§ 141.23(c), 141.23(e) and/or 141.24(g) and (h) may decrease the frequency of its monitoring, and a list of all systems which the State has determined pursuant to §§ 141.23(g), and 141.24(g)(13) and 141.24(h)(18), that it must increase monitoring frequency. The report shall include the basis for the State's decisions and the new required monitoring frequency.

(14) A list, including the PWS identification number, of all systems which the State has determined must conduct repeat monitoring for asbestos, the basis for that determination, and the frequency of such repeat monitoring.

(15) The results of any monitoring conducted for the contaminants listed in § 141.40(n), (o), and (p).

(16) A list, including the PWS identification number, of those systems serving under 150 service connections which have sent letters to the State stating that their systems are available for sampling for the contaminants listed in §§ 141.40(n) and 141.40(o).

(17) A list, including the PWS identification number, of those systems which certified compliance with the treatment technique for acrylamide and epichlorohydrin specified in Part 141, Subpart K.

\* \* \*

4. Section 142.16 is amended by reserving paragraphs (b) through (d) and by adding a new paragraph (e) to read as follows:

##### § 142.16 Special Primacy Requirements.

\* \* \*

(b)–(d) [Reserved]

(e) An application for approval of a State program revision which adopts the requirements specified in §§ 141.23, 141.24, 141.40, 141.61, and 141.62 must contain the following:



(1) The procedure the State will use to conduct vulnerability assessments as required by §§ 141.23, 141.24, and 141.40. The procedure must include the factors the State will use in conducting vulnerability assessments and the method the State will use to inform the system of its classification as either vulnerable or not vulnerable. The procedure shall also include provisions for reclassification of systems and the factors the State will use in reclassifying.

(2) The procedure the State will use in determining that a system may decrease the frequency of its monitoring (as provided for by §§ 141.23 and 141.24), including the factors a State will use in making this determination as well as the method the State will use to inform the system of its new required monitoring frequency.

5. Section 142.57 is revised to read as follows:

**§ 142.57 Bottled water and point-of-use devices.**

(a) A State may require a public water system to use bottled water or point-of-use devices as a condition for granting an exemption from the requirements of §§ 141.61(a) and 141.62 of this part.

(b) Public water systems that use bottled water as a condition of obtaining an exemption from the requirements of §§ 141.61(c) and 141.62 must meet the requirements set out in § 142.62(f) of this part.

(c) Public water systems that use point-of-use devices as a condition for receiving an exemption must meet the requirements set out in § 142.62(g) of this part. Public water systems that use point-of-use devices as a condition for receiving an exemption must meet the requirements set out in § 141.64(f) of this part.

6. Section 142.62 is revised to read as follows:

**§ 142.62 Variances and exemptions from the maximum contaminant levels for synthetic organic and inorganic chemicals.**

(a) The Administrator, pursuant to section 1415(a)(1)(A) of the Act hereby identifies the technologies listed in paragraphs (a)(1) through (a)(36) of this section as the best technology, treatment techniques, or other means available for achieving compliance with the maximum contaminant levels for synthetic organic chemicals as listed in § 141.61 (a) and (c) and the maximum contaminant levels for inorganic chemicals listed in this § 141.62.

Best available technologies	Contaminant	
	Packed tower aeration	Granular activated carbon
(1) Benzene .....	X	X
(2) Carbon tetrachloride .....	X	X
(3) 1,2-Dichloroethane .....	X	X
(4) Trichloroethylene .....	X	X
(5) para-Dichlorobenzene .....	X	X
(6) 1,2-Dichloroethylene .....	X	X
(7) 1,1,1-Trichloroethane .....	X	X
(8) Vinyl chloride .....	X	X
(9) cis-1,2-Dichloroethylene .....	X	X
(10) 1,2-Dichloropropane .....	X	X
(11) Ethylbenzene .....	X	X
(12) Monochlorobenzene .....	X	X
(13) o-Dichlorobenzene .....	X	X
(14) Styrene .....	X	X
(15) Tetrachloroethylene .....	X	X
(16) Toluene .....	X	X
(17) trans-1,2-Dichloroethylene .....	X	X
(18) Xylenes (total) .....	X	X
(19) Alachlor .....	X	X
(20) Aldicarb .....	X	X
(21) Aldicarb sulfide .....	X	X
(22) Aldicarb sulfone .....	X	X
(23) Atrazine .....	X	X
(24) Carbofuran .....	X	X
(25) Chlordane .....	X	X
(26) Dibromochloropropane .....	X	X
(27) 2,4-D .....	X	X
(28) Ethylene dibromide .....	X	X
(29) Heptachlor .....	X	X
(30) Heptachlor epoxide .....	X	X
(31) Lindane .....	X	X
(32) Methoxychlor .....	X	X
(33) PCBs .....	X	X
(34) Pentachlorophenol .....	X	X
(35) Toxaphene .....	X	X
(36) 2,4,5-TP .....	X	X

(b) A State shall require community water systems and non-transient, non-community water systems to install and/or use any treatment method identified in § 142.62(a) as a condition for granting a variance except as provided in paragraph (c) of this section. If, after the system's installation of the treatment method, the system cannot meet the MCL, that system shall be eligible for a variance under the provisions of section 1415(a)(1)(A) of the Act.

(c) If a system can demonstrate through comprehensive engineering assessments, which may include pilot plant studies, that the treatment methods identified in § 142.62(a) would only achieve a *de minimus* reduction in contaminants, the State may issue a schedule of compliance that requires the system being granted the variance to examine other treatment methods as a condition of obtaining the variance.

(d) If the State determines that a treatment method identified in paragraph (c) of this section is technically feasible, the Administrator or primacy State may require the system to install and/or use that treatment method in connection with a compliance

schedule issued under the provisions of section 1415(a)(1)(A) of the Act. The State's determination shall be based upon studies by the system and other relevant information.

(e) The State may require a public water system to use bottled water or point-of-use devices or other exemption from the requirements of § 141.61 (a), (c) or this § 141.62 to avoid an unreasonable risk to health.

(f) Public water systems that use bottled water as a condition for receiving a variance or an exemption from the requirements of § 141.61 (a), (c) or this § 141.62 must meet the requirements specified in either paragraph (f)(1) or (f)(2) of this section in addition to requirements in paragraph (f)(3) of this section:

(1) The Administrator or primacy State must require and approve a monitoring program for bottled water. The public water system must develop and put in place a monitoring program that provides reasonable assurances that the bottled water meets all MCLs. The public water system must monitor a representative sample of the bottled water for all contaminants regulated under § 141.61 (a), (c) and § 141.62 the first quarter that it supplies the bottled water to the public, and annually thereafter. Results of the monitoring program shall be provided to the State annually.

(2) The public water system must receive a certification from the bottled water company that the bottled water supplied has been taken from an "approved source" as defined in 21 CFR 129.3(a); the bottled water company has conducted monitoring in accordance with 21 CFR 129.80(g) (1) through (3); and the bottled water does not exceed any MCLs or quality limits as set out in 21 CFR 103.35, 110, and 129. The public water system shall provide the certification to the State the first quarter after it supplies bottled water and annually thereafter.

(3) The public water system is fully responsible for the provision of sufficient quantities of bottled water to every person supplied by the public water system, via door-to-door bottled water delivery.

(g) Public water systems that use point-of-use devices as a condition for obtaining a variance or an exemption from NPDWRs must meet the following requirements:

(1) It is the responsibility of the public water system to operate and maintain the point-of-use treatment system.

(2) The public water system must develop a monitoring plan and obtain State approval for the plan before point-



of-use devices are installed for compliance. This monitoring plan must provide health protection equivalent to a monitoring plan for central water treatment.

(3) Effective technology must be properly applied under a plan approved by the State and the microbiological safety of the water must be maintained.

(4) The State must require adequate certification of performance, field testing, and, if not included in the certification process, a rigorous engineering design review of the point-of-use devices.

(5) The design and application of the point-of-use devices must consider the tendency for increase in heterotrophic bacteria concentrations in water treated with activated carbon. It may be necessary to use frequent backwashing, post-contactor disinfection, and Heterotrophic Plate Count monitoring to ensure that the microbiological safety of the water is not compromised.

(6) All consumers shall be protected. Every building connected to the system must have a point-of-use device installed, maintained, and adequately monitored. The State must be assured that every building is subject to treatment and monitoring, and that the rights and responsibilities of the public water system customer convey with title upon sale of property.

7. A new § 142.64 is added to Subpart G to read as follows:

**§ 142.64 Variances and exemptions from the maximum contaminant levels for the inorganic contaminants listed in § 141.62.**

(a) The Administrator, pursuant to section 1415(a)(1)(A) of the Act, hereby identifies the following as the best technology, treatment techniques, or other means available for achieving compliance with the maximum contaminant levels for the inorganic contaminants listed in § 141.62:

**BAT FOR INORGANIC COMPOUNDS LISTED IN SECTION 141.62(b)**

CAS No.	Chemical name	BAT(s)
	Asbestos.....	2, 3, 8
	Barium.....	5, 6, 7
	Cadmium.....	2, 5, 6, 7
	Chromium.....	2, 5, 6 <sup>2</sup> , 7
	Mercury.....	2 <sup>1</sup> , 4, 6 <sup>1</sup> , 7 <sup>1</sup>
	Nitrate.....	5, 7
	Nitrite.....	5, 7
	Selenium.....	1, 2 <sup>3</sup> , 6, 7

<sup>1</sup> BAT only if influent Hg concentrations < 10 ug/l.

<sup>2</sup> BAT for Chromium III only.

<sup>3</sup> BAT for Selenium IV only.

**Key to BATs in Table**

1= Activated Alumina

2= Coagulation/Filtration (not BAT for systems < 500 service connections)

3= Direct and Diatomite Filtration  
4= Granular Activated Carbon  
5= Ion Exchange  
6= Lime Softening (not BAT for systems < 500 service connections)  
7= Reverse Osmosis  
8= Corrosion Control

(b) A State shall require community water systems and non-transient, non-community water systems to install and/or use any treatment method identified in § 141.64(a) as a condition for granting a variance except as provided in paragraph (c) of this section. If, after the system's installation of the treatment method, the system cannot meet the MCL, that system shall be eligible for a variance under the provisions of section 1415(a)(1)(A) of the Act.

(c) If a system can demonstrate through comprehensive engineering assessments, which may include pilot plant studies that the treatment methods identified in § 141.64(a) would only achieve a *de minimis* reduction in contaminants, the State may issue a schedule of compliance that requires the system being granted the variance to examine other treatment methods as a condition of obtaining the variance.

(d) If the State determines that a treatment method identified in paragraph (c) of this section is technically feasible, the Administrator or primacy State may require the system to install and/or use that treatment method in connection with a compliance schedule issued under the provisions of section 1415(a)(1)(A) of the Act. The State's determination shall be based upon studies by the system and other relevant information.

(e) The State may require a public water system to use bottled water or point-of-use devices or other means as a condition of granting a variance or an exemption from the requirements of § 141.62, to avoid an unreasonable risk to health.

(f) Public water systems that use bottled water as a condition for receiving a variance or an exemption from the requirements of § 141.62 must meet the following requirements in either paragraph (f)(1) or (f)(2) of this section in addition to requirements in paragraph (f)(3) of this section:

(1) The Administrator or primacy State must require and approve a monitoring program for bottled water. The public water system must develop and put in place a monitoring program that provides reasonable assurances that the bottled water meets all MCLs. The public water system must monitor a representative sample of the bottled water for all contaminants regulated under § 141.62 the first quarter that it

supplies the bottled water to the public, and annually thereafter. Results of the monitoring program shall be provided to the State annually.

(2) The public water system must receive a certification from the bottled water company that the bottled water supplied has been taken from an "approved source" as defined in 21 CFR 129.3(a); the bottled water company has conducted monitoring in accordance with 21 CFR 129.80(g) (1) through (3); and the bottled water does not exceed any MCLs or quality limits as set out in 21 CFR 103.35, 110, and 129. The public water system shall provide the certification to the State the first quarter after it supplies bottled water and annually thereafter.

(3) The public water system is fully responsible for the provision of sufficient quantities of bottled water to every person supplied by the public water system, via door-to-door bottled water delivery.

(g) Public water systems that use point-of-use devices as a condition for obtaining a variance or an exemption from NPDWRs for inorganic compounds must meet the following requirements:

(1) It is the responsibility of the public water system to operate and maintain the point-of-use treatment system.

(2) The public water system must develop a monitoring plan and obtain State approval for the plan before point-of-use devices are installed for compliance. This monitoring plan must provide health protection equivalent to a monitoring plan for central water treatment.

(3) Effective technology must be properly applied under a plan approved by the State and the microbiological safety of the water must be maintained.

(4) The State must require adequate certification of performance, field testing, and, if not included in the certification process, a rigorous engineering design review of the point-of-use devices.

(5) The design and application of the point-of-use devices must consider the tendency for increase in heterotrophic bacteria concentrations in water treated with activated carbon. It may be necessary to use frequent backwashing, post-contactor disinfection, and Heterotrophic Plate Count monitoring to ensure that the microbiological safety of the water is not compromised.

(6) All consumers shall be protected. Every building connected to the system must have a point-of-use device installed, maintained, and adequately monitored. The State must be assured that every building is subject to treatment and monitoring, and that the



rights and responsibilities of the public water system customer convey with title upon sale of property.

#### PART 143—NATIONAL SECONDARY DRINKING WATER REGULATIONS

1. The authority citation for Part 143 continues to read as follows:

Authority: 42 U.S.C. 300g-1(c), 300j-4, and 300j-9.

2. In § 143.3 the table is revised to read as follows:

#### § 143.3 Secondary maximum contaminant levels.

Contaminant	Level
Aluminum.....	0.05 mg/l.
Chloride.....	250 mg/l.
Color.....	15 color units.
Copper.....	1 mg/l.
Corrosivity.....	Non-corrosive.
o-Dichlorobenzene.....	0.01 mg/l.
p-Dichlorobenzene.....	0.005 mg/l.
Ethylbenzene.....	0.03 mg/l.
Fluoride.....	2 mg/l.
Foaming agents.....	0.5 mg/l.
Iron.....	0.3 mg/l.
Manganese.....	0.05 mg/l.

Contaminant	Level
Odor.....	3 threshold odor number
Pentachlorophenol.....	0.03 mg/l.
pH.....	6.5-8.5.
Silver.....	0.09 mg/l.
Styrene.....	0.01 mg/l.
Sulfate.....	250 mg/l.
Toluene.....	0.04 mg/l.
Total dissolved solids (TDS).....	500 mg/l.
Xylenes (total).....	0.02 mg/l.
Zinc.....	5 mg/l.

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